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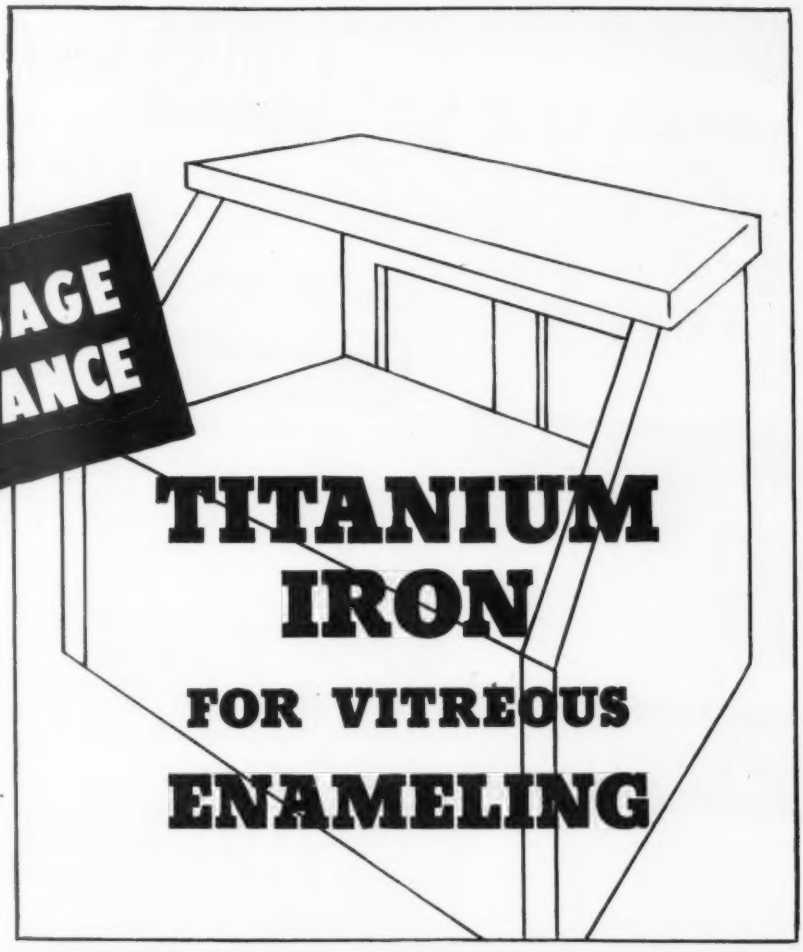

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24 Ga. Titanium Steel	57
18 Ga. Standard Enameling Iron	100
18 Ga. Titanium Steel	18

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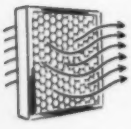

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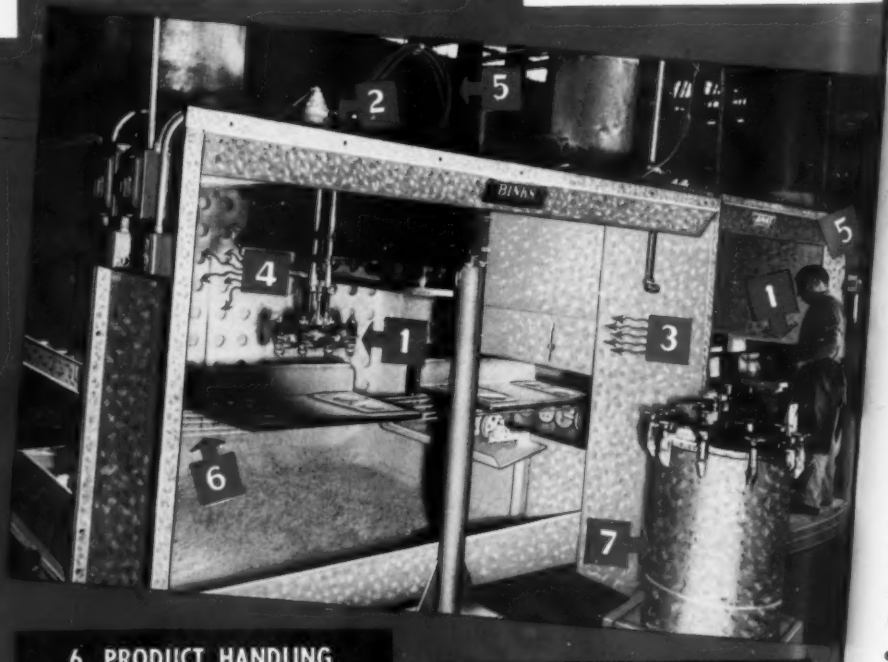

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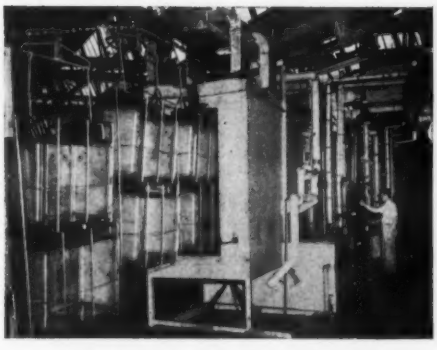

Ware entering single tunnel Spray Pickler

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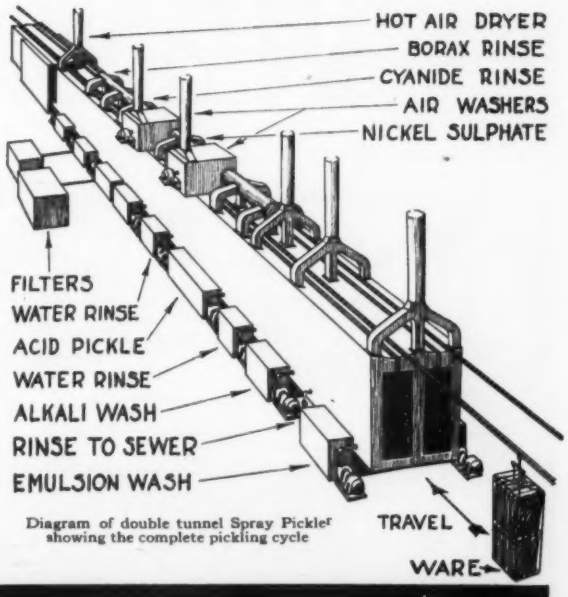

Diagram of double tunnel Spray Pickler showing the complete pickling cycle

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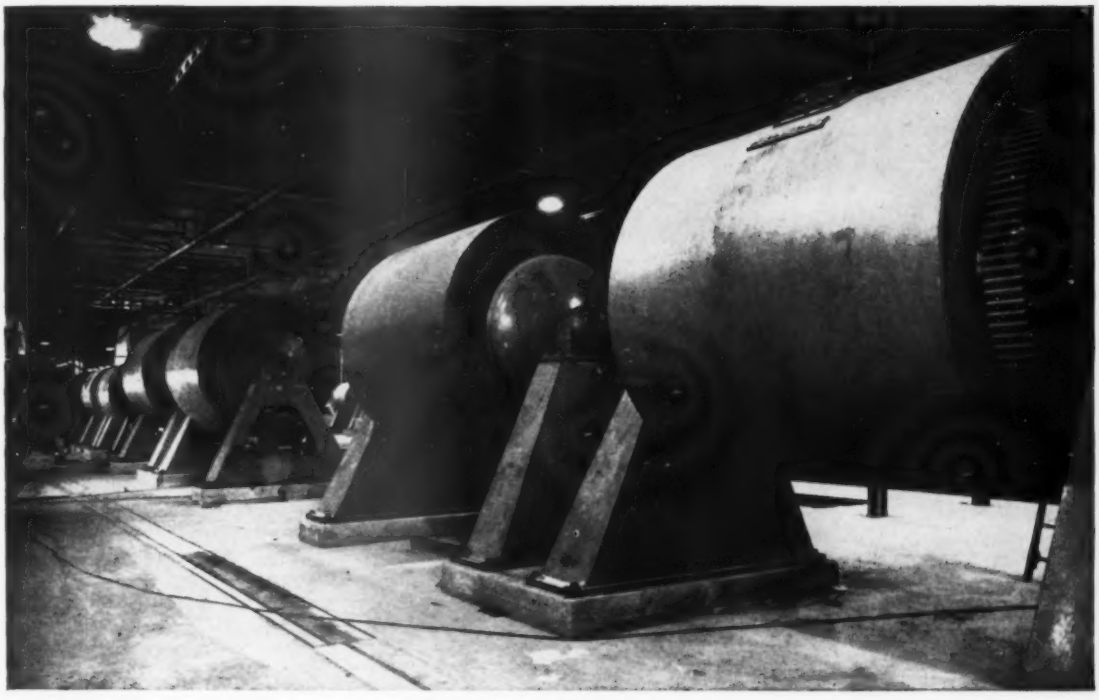

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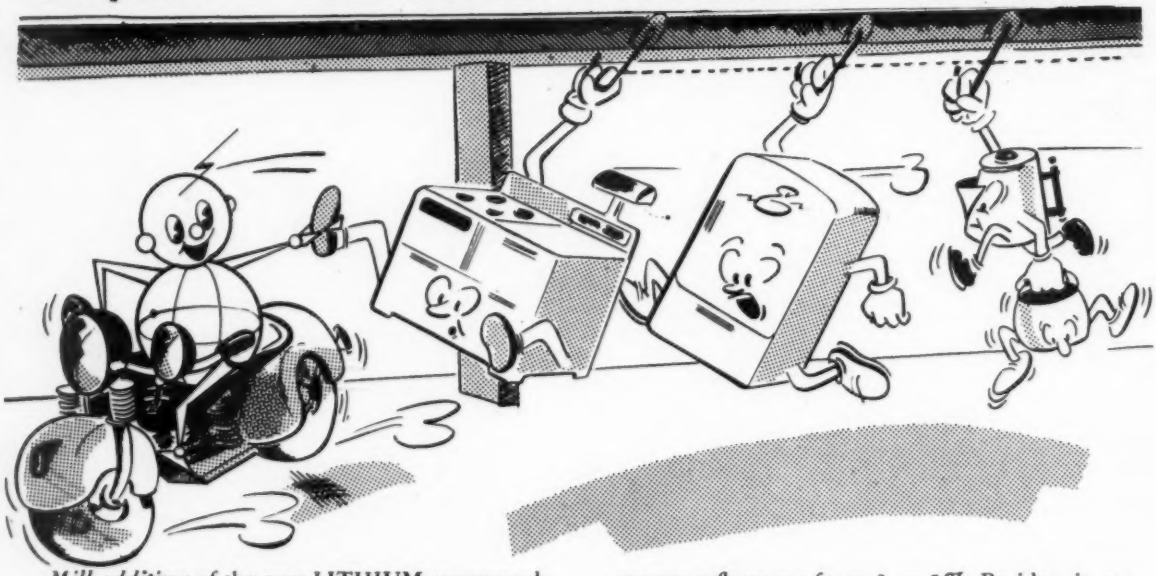

Mill additions of the new LITHIUM compounds, which you can now get in any quantity, will work wonders in your titania covercoat enamels. Because these compounds are such powerful fluxes, fractional percentages are remarkably effective. This makes them inexpensive for you to use.

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THE Finish Line

AN IDEA GROWS – in proportion to the ability, enthusiasm, and forcefulness of those responsible for putting it into action.

The basic idea presented by *finish*, and described in "The Finish Line" in earlier issues, concerned the detailed organization of a Packaging and Shipping Committee whose job it would be to develop procedures for relief from the tremendous "loss in shipment" on finished products, porcelain enameled products in particular. The idea included a coordinating effort to be sponsored by the PEI. All interested industry manufacturers' associations, the carriers, and the packaging industry would play an important part in this cooperative work.

Speedy action

Not only did the alert Porcelain Enamel Institute organization grasp this opportunity to be of service to all manufacturing groups, but it whirled into action immediately with the appointment of Ralph Bisbee, of Westinghouse, as chairman of the Coordinating Committee; Ev Shands, of Roper, to head the Technical Planning Division; and other active industry men to spearhead the movement.

Tentative testing procedure developed

The Technical Planning Division of the PEI Packaging and Shipping Committee has already developed specific testing procedures, based on past experience and existing data, for pre-proving the ability of porcelain enameled packaged products to travel to their destinations undamaged. The testing equipment recommended includes: a shock recording instrument which can be attached to the packaged product under test and which will automatically record the longitudinal impact and vertical vibration created by the test; an impact testing device which can produce a variable degree of longitudinal impact or shock; and a vibration tester which can produce a variable degree of vertical movement and reach stages of harmonic vibration.

Carriers' cooperation assured

A big step forward in assuring success of the program to defeat product shipping and handling damage, and to reduce freight claims, lies in the recent endorsement by three major carriers' groups of both the testing equipment selected and the severity and duration of the tests.

Chairman Bisbee, Mr. Shands, and other members of the Committee met with A. L. Green, of the Association of American Railroads; A. E. Dowling, of Railway Express Agency, Inc., and W. L. Yingling, of American Trucking Association, for consideration of the specifications and demonstrations of the equipment suggested.

The impact tester, which consists of a railed surface inclined at about a 60 degree angle and a wheeled dolly upon which the packaged product rides to an abrupt stop against a solid bumper, will be operated from the fifth zone on the inclined plane. This was agreed as sufficiently severe to approximate not only transit hazards but also the loading and unloading abuse which must be considered.

The vertical vibration test was agreed to satisfactorily simulate average transit vibration if operated at a frequency rate of 1 g. (a unit of measurement which defines both length and frequency of vibration) for a duration of one hour. The two-way shock recorder was also approved as a suitable instrument to record test intensity.

Following the meeting, all three carriers' groups endorsed the testing equipment, and agreement was reached on the severity and time constants required. In addition, the carriers' representatives agreed to inaugurate educational programs within their own memberships to parallel the Coordinating Committee efforts, and to make all possible improvements in handling conditions and facilities.

No product specifications contemplated

In speaking for the Technical Planning Division, Mr. Shands made it plain that the purpose of the current PEI program is not to select, or proclaim the merits of, any particular package or packaging method, but to provide manufacturers of porcelain enameled products with a means of determining whether the packaged product can be expected to arrive at its destination undamaged. *The design of the package and product, and packaging method, will be the concern of the individual manufacturer.*

It is anticipated that most of the larger manufacturers will invest in their own testing equipment, since the total cost of all equipment required is estimated at not over $2,000, a sum which could be saved within a short period through reduction in product losses.

No particular brand of equipment will be specified, as long as the equipment purchased performs according to the standards which will be finally agreed upon by all concerned.

In addition to individual plant installations of the testing equipment, independent testing laboratories will be asked to install the equipment for service to small manufacturers who may wish to participate without purchasing their own equipment, and also to act as umpire testers.

Industry committee to meet

As this issue of *finish* goes in the mails, final plans will have been completed for a meeting of the industry committee which includes representatives from all of the major manufacturing associations.

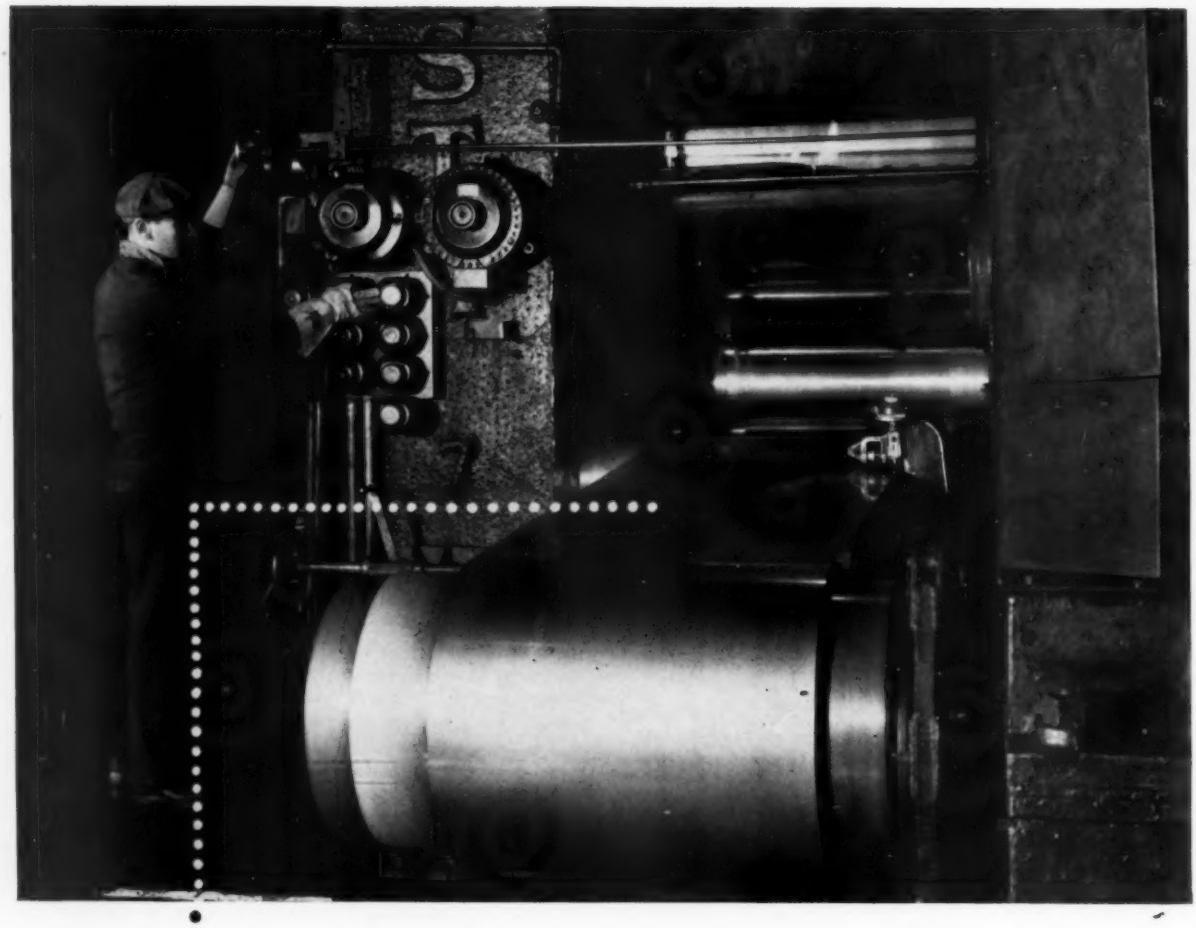
The groups represented by these men and the individual companies within these groups are the ones who will gain most from this cooperative effort. At the same time, they are the ones who will be responsible for the effective advancement of the complete plan.

The tentative plan will be outlined in detail before these industry representatives, and it is sincerely hoped in the interests of everyone concerned that speedy agreement will be reached.

Comments to *finish* from individual manufacturers indicate strong enthusiasm for this project which should ultimately benefit *everyone* concerned. The speed with which this enthusiasm is turned into action will be the answer to early results in this cooperative campaign to reduce shipping losses.

Dana Chase

EDITOR AND PUBLISHER



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The introduction of lithium compounds

in titania enamels

By Dr. Paul A. Huppert

Exclusive feature finish

A description is given of a variety of tests carried out by introducing chemically precompounded lithium compounds in titanium bearing super-opaque cover coat enamels used either in the mill or in the batch composition of the frit. The results of the most promising experiments are discussed, especially as to the influence of these lithium compounds on color and reflectance stability, and on smelting and firing conditions.

I Introduction

After the successful introduction of lithium compounds into ground coat and dark colored single coat enamels[1], it was obvious that a study of the influence of the colorless lithium compounds on cover coat enamels was in order. From the very beginning all the work was confined to use with super-opaque titanium enamels which represent, so far, the latest stage in the development of new enamel frit compositions.

It is well known that the use of this new type of enamel offers, on the one hand, great advantages but, on the other hand, a number of difficulties that have to be overcome by adjustments in smelting, milling, applying, and firing, in order to reach highest possible reflectance and smooth glossy finish, together with a neutral or stable white color. Among other factors influencing discoloration, too high or too extended firing is detrimental to color stability of titanium white enamels[2]. It could, therefore, be expected that by making use of the powerful fluxing characteristics of small additions of lithium compounds, burning conditions would be favorably influenced and so—directly or indirectly — the presence of these lithium compounds would improve final results.

The use of lithia, added in the form of lithium carbonate, in white enamels in general and in titania enamels in particular, is not new, and has been mentioned in both the American and German literature[3] on several occasions. From some preliminary tests on cover coat enamels, however, it was evident that it made a difference if lithia was introduced as the carbonate or if chemically precompounded lithium compounds were employed. This was very similar to the effect of lithium manganite reported previously in dark colored enamels.

In this connection it should also be of interest to quote a very old German report[4] which states, among other findings, that lithium does not replace alkalies, but rather alkaline earth oxides and/or salts.

II Discoloration of titania enamels

Since this paper primarily deals with the effect of lithium compounds on color and reflectance stability of titania enamels, it is thought advisable to review in general all the factors known so far to be of influence on color and reflectance although the experience on this subject is not far enough advanced to permit many definite statements.

For a long time it was a common belief that the iron oxide content of titania enamels, introduced as impurities either from the titanium dioxide or from other batch raw materials, was the sole reason for a discoloration that will vary from a slight creamy tinge to a brownish, even dirty looking color. The German literature of the later war years[5] refers especially to this fact. Recent research reports, however, prove that chromium and even vanadium oxide contents are more dangerous than iron oxide[2].

From the intensive work carried out on this subject, it has been learned that the tendency towards

Chart 1

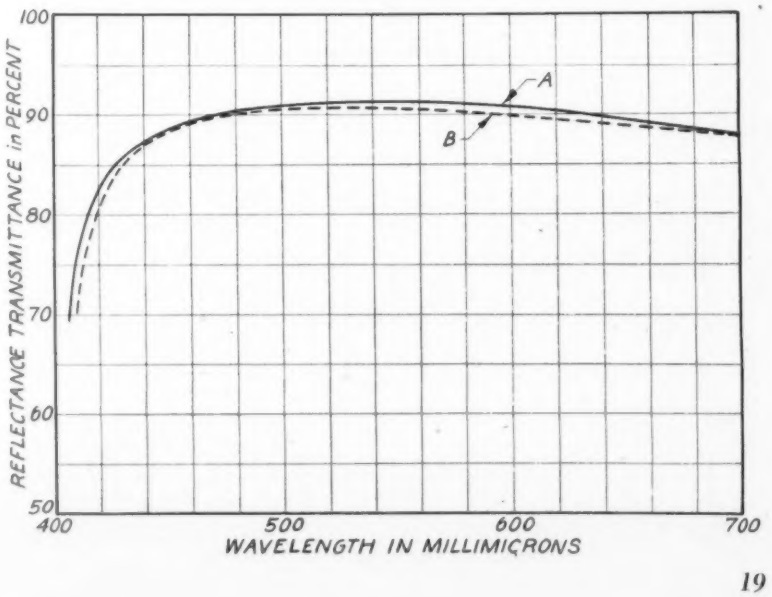


TABLE I

Oxide Composition of Titania Enamels Used in Tests

(Fluorides calculated as oxides)

Enamel No.	1	2	3
Na_2O	8.99	10.2	8.18
K_2O	6.92	1.76	4.91
ZnO	1.54	1.—	
MgO	.73	2.05	
CaO	—.51	1.07	
B_2O_3	13.22	13.2	12.1
Al_2O_3	1.42	.93	1.54
SiO_2	46.98	54.2	56.—
TiO_2	19.75	15.5	16.95
Sb_2O_5		.23	
	100.06	100.14	99.68
Calculated cubical coefficient of expansion x 10^{-7}	277.1	230.8	236.0

This table of the oxide composition of some of the typical titania enamels used shows that even though a wide variety of frit combinations were tested, they all gave similar results when lithia was introduced in the one form or the other.

discoloration can equally be influenced by any one or a combination of the following factors:

Frit composition.

Smelting practice.

Choice of mill additions.

Application and burning procedure.

In the frit composition, variations in alkali, ratio of boric acid to alkali, amount and type of alkaline earths, small additions of antimony oxide, source of fluorine, percentage of zinc oxide, as well as a certain equilibria among the various groups of ingredients together with type and amount of the titanium dioxide itself, are liable to produce any desired or undesired shade of white color.

Attention must be paid to the proper smelting practice, to reducing or oxidizing atmosphere of the smelter, to smelting time and temperature, to stirring, and especially to the proper "soaking" time and temperature, i.e., the treatment of the batch after the smelting period proper is over, and also to the speedy discharging of the readily smelted frit.

As to mill additions, it seems that clear clays of the kaolin type are preferable, but equally important is the amount of clay, choice of setting-up agents, fineness of grinding, and specific gravity of the liquid enamels, perhaps even the aging time.

In the application of the enamel, the thickness of coating and the number of coats used will cause certain variations, as well as the method of application, i.e., whether the enamels are sprayed, dipped, or drained.

Consideration for burning time

But above all, consideration must be given to the burning time and temperature which will be characteristic for any particular titania enamel. While as a rule any enamel will have a proper range of burning time and temperature, in almost every case it can be found that snappy firing, i.e., lower time at higher temperatures, deserves preference. Above a certain burning temperature limit, however, any titanium enamel is likely to discolor.

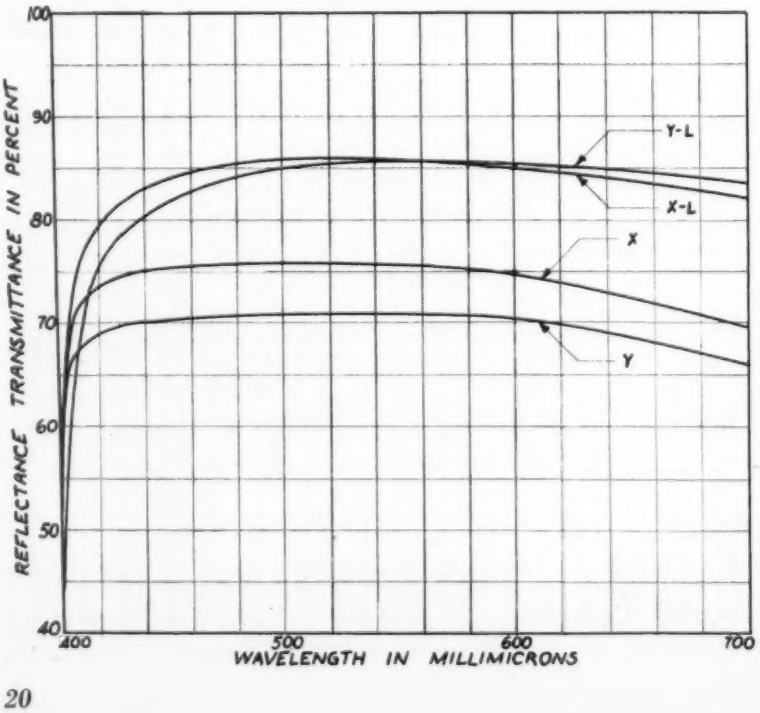
III Lithium compounds in titania enamels

The tests, introducing lithium compounds, were conducted especially from the standpoint of reducing burning time and burning temperature. A theory has already been advanced by other workers which held that the opacity increases while the tendency towards discoloration decreases in direct ratio to the amount of anatase crystals to rutile crystals present in the finished fired enamel. It has also been stated that after a certain temperature has been reached, typical for every individual titania enamel, a gradual conversion from anatase to rutile crystals takes place.

Practical procedure

Experiments were carried out in two directions: (a) by using various lithium compounds as mill additions both with commercial frits of unknown compositions and with self prepared frits of known compositions, and (b) by introducing some of the lithium compounds in the smelter

Chart 2



using various basic titanium bearing formulae.

The lithium compounds available for these tests were the following:

Lithium titanate	Li_2TiO_3
" silicate	Li_2SiO_3
" zirconate	Li_2ZrO_3
" zirconium silicate	$2Li_2O{\cdot}ZrO_2{\cdot}SiO_2$
" carbonate	Li_2Co_3
" fluoride	LiF
" hydroxide (monohydrate)	$LiOH{\cdot}H_2O$
" molybdate	Li_2MoO_4
" meta borate	$LiBO_2\,2H_2O$

The compounds which have given best results so far are as follows:

Lithium titanate, a white fluffy powder, insoluble in water, mol. weight = 109.78, 27.2% lithium content.

Lithium zirconate, a creamy-white powder, insoluble in water, mol. weight = 153.10, 19.5% lithium content.

Lithium zirconium silicate, a white powder, insoluble in water, mol. weight = 243.0, 24.6% lithium content.

Lithium silicate, a white powder, insoluble in water, mol. weight = 89.94, with 33.2% lithium content, of a density of 2.52 gm/cc at 25° C., melting point 1201° C.

After certain preliminary tests, those compounds were selected which showed the most promising results both by reason of freedom of blistering as well as of the introduction of favorable properties. Special attention was paid to the influence of these materials on smelting and firing conditions, and on the appearance of the finished ware with respect to color stability and to opacity.

The formulae of the typical titanium bearing cover coat enamels used in this experimental series have an oxide composition as listed in Table I.

The standard mill additions used were:

5% airfloated clay of kaolin type
0.5% sodium nitrate
0.25% bentonite
0.1% calcium chloride

The commercial frits were of various sources; parallel tests were, however, carried out with the same basic frits.

TABLE II

Influence of Lithium Compounds as Mill Additions

	Per cent reflectance on photovoltmeter with filter			Solubility acid resistance test (Loss in grams)
	Amber	Blue	Green	
Commercial frit "A"				
(a) Without lithium burned at 1560° 2½ min.	87.6	85.–	87.6	.0007
(b) Lithium added burned at 1540° 1¾ min.				
With 1% lithium titanate	88.–	85.–	89	.0007
1% lithium zirconate	88.2	85.–	88.–	.0006
1% lithium zirconium silicate	88.–	85.3	88.–	.0007
Commercial frit "B"				
(a) Without lithium burned at regular condition	79	79	79	.0006
(b) With 1% lithium titanate added burned at low temperature and time	82	82	82	.0004

Prepared frit No. 2 "M"* (See Table I)	Total thickness in mils in center	average on 4 corners	Per cent reflectance on green filter only
(a) Without lithium	8	5.5	76
(b) With ½% lithium titanate added	7	5.7	80.4

* "M" signifies frit No. 2 oversmelted.

Lithium compounds as mill additions

Although it seems quite possible that other lithium compounds can give equally favorable results if certain conditions and mill additions can be adjusted, the work was carried on with those compounds which improved the finish enamel under regular working conditions by simply adding a low percentage to the standard mill additions. The three compounds which proved best under these conditions were lithium titanate, lithium zirconate, and lithium zirconium silicate.

Lithium silicate was effective too.

Chart 3

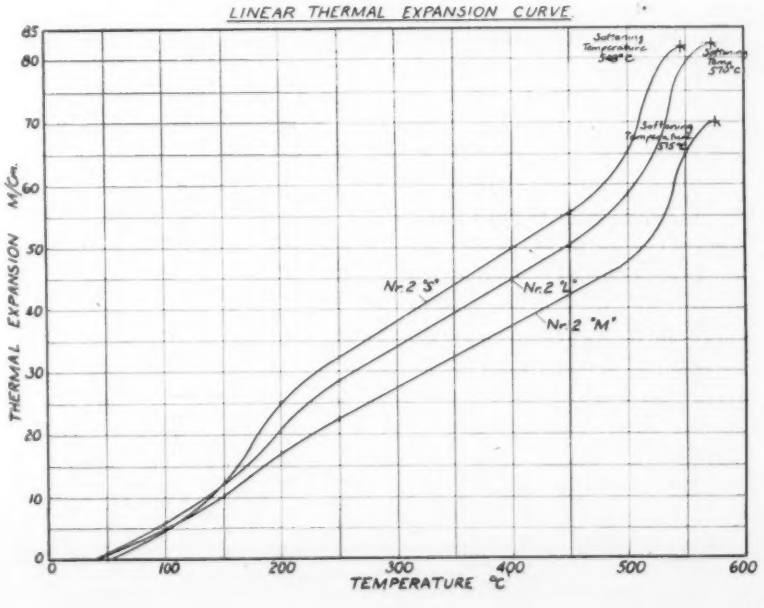


TABLE III

Influence of Smelting Conditions and of Lithia Additions

	Gloss	Total thickness in mils	Average per cent reflectance on green filter only	Acid resistance
Frit No. 2				
(a) Oversmelted "M"	fair	8.	76	.0012
(b) Regularly smelted "L"	fair	9.5	80	.0008
(c) 1½% lithium silicate added "S"	very good	8.9	80.5	.0005

Samples (a) and (b) fired under regular burning conditions.
Sample (c) burned at reduced burning time and temperature.

	Thermal expansion M/Cm. at 200° C.	at 300° C.	at 400° C.	at 500° C.	Softening temperature
(a) Oversmelted "M"	17	26.5	36	46.5	575° C.
(b) Regularly smelted "L"	20.5	33.5	44	57	570° C.
(c) Lithia added "S"	25	39.5	50	65	548° C.

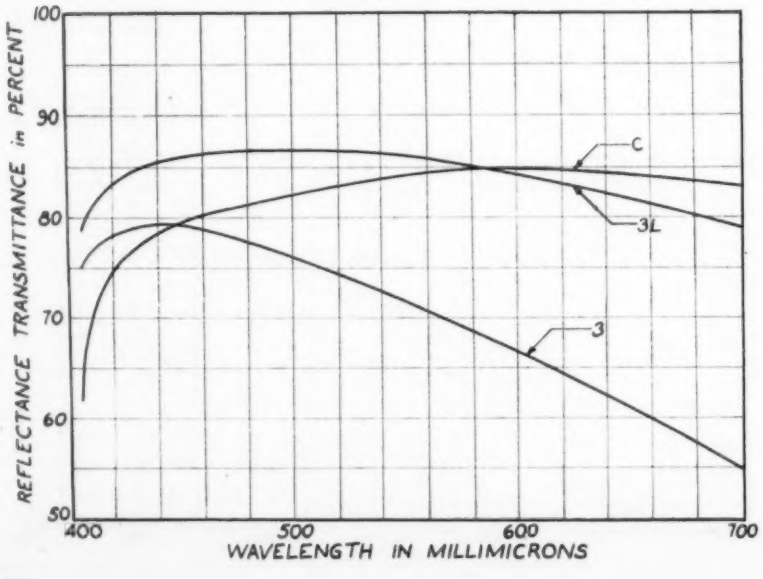
However, its tendency to deflocculate, similar in effect to sodium silicate, renders its use as a mill addition undesirable. This condition can be overcome by adding a more powerful electrolyte, such as 0.1 to 0.2% of calcium chloride, but the set of the enamel proved unstable and further addition of electrolyte became necessary after several hours. For this reason further tests with this compound in the mill were abandoned. Although at higher percentage additions the deflocculation changes into a setting-up reaction, such an application seems to be of no practical value from an economical standpoint.

Using lithium titanate, lithium zirconate, and lithium zirconium silicate it was possible to change the regular burning conditions of a commercial titanium enamel "A" from 1560° F. in 2½ minutes to 1540° F. in 1¾ minutes. Average reflectance readings thus obtained are shown in Table II. The acid resistance remained about the same, and equally good results were obtained using the Taber abrasion test which varied from .0072 to .0078 gr. loss after 25000 wearing cycles with a load of 1000 gr. Some spectrophotometric curves are shown in Chart I.

The results of a commercial enamel "B" which was slightly lower in reflectance, however, on the bluish side, are also demonstrated in Table II. While the acid resistance remained equally good after introducing the lithium compound into this frit "B", which is slightly harder than the frit "A", the opacity improved by a few points and the neutral color was still maintained.

When testing frit 2"M", which was lower in reflectance since it was oversmelted, it was found that higher opacity could be obtained by adding 0.5% of lithium titanate to the mill. The comparison is also shown in Table II.

Chart 4



Lithium compounds as raw batch additions

A different and, in some respects, even more remarkable action results from lithium compound additions in the smelter. In addition to lower burning conditions on regular titanium compositions, two other sorts of improvements were especially noticed:

(a) With harder compositions, having low calculated coefficients of expansion, the result was a reduction of smelting time and temperature together with better finish, in spite of the lower burning conditions.

(b) On formulae rather high in titania it was possible to decrease the percentage of the titania without influencing the opacity, gloss, acid resistance and surface hardness, even when burned at lower temperatures.

After a series of preliminary tests, it was determined that for smelter additions lithium silicate was preferable. Therefore, almost all the work described herewith was based on an addition of 1½% of lithium silicate, without otherwise changing the original composition.

A basic formula, used on regular production runs, was smelted with two variations, one with potassium carbonate and potassium nitrate (Frit "X" on chart No. 2) and one with sodium carbonate and sodium nitrate, replacing the potassium salts on a weight basis (Frit "Y" on Chart 2).

In both cases the introduction of lithium silicate effected a reduction of about 100° F. in the smelting

temperature and a reduction of 30 minutes of the smelting time without otherwise influencing the smelting procedure. (Frit "X-L" and Frit "Y-L" on Chart 2.)

When burning these two enamels milled and applied under normal conditions in the same manner as regular titania enamels, a significant change in time and temperature relationships was effected. Both burning time and temperature were considerably reduced without changing reflectance, gloss or color of the enamels. Whatever burning time and burning temperature had been chosen, every sample showed good opacity and an almost neutral white, with satisfactory freedom of discoloration.

These burning time/temperature combinations were as follows:

Burning Temperature	Burning Time	Per cent reflectance (average on green filter only)
1500° F.	2.2 minutes	82
1510° F.	2 "	82
1540° F.	1.8 "	83

A higher temperature and shorter buring time seemed to improve opacity slightly.

Spectrophotometric curves of these four enamels are shown in Chart 2. With the addition of lithia an improved opacity by about 9% and more is noted. The curves are also more even, especially in the range above 550 millimicron wave length, i.e., in the range of yellow-orange and beyond.

Surprisingly, the curve of the enamel "Y-L", which contained sodium compounds, shows even better characteristics than the curve of the potassium bearing enamel "X-L". In the presence of lithia, therefore, the relative effects of potassium versus sodium are apparently different, either directly due to the presence of the lithia, or to the reduced burning time and temperature of the enamel. Of course, from an economical standpoint, this change is important since the sodium compounds are the cheaper ones.

No defects, such as tearing, black specking, cracking under the bead (on hollow ware), were encountered when the enamels were milled correctly with the proper mill additions and to the consistency of the slip found to be most suitable.

Based on this experience lithium silicate was introduced in other recommended smelter formulae with about equal results. For instance, an enamel No. 4, a hard composition was tried using lithia additions and the reflectance was increased as follows:

	Aver. total thickness* mils	Aver. per cent reflectance (green filter only)	Acid resistance
(a) Frit No. 4 without lithium	8.4	80.3	.0009
(b) Frit No. 4 with lithium	8.1	84.0	.0008

Since this frit No. 4 was a rather hard composition it was almost impossible to burn to a glossy finish under regular burning conditions before adding the lithia. The acid resistance, using the boiling acid solubility test, was about the same for both enamels, without and with lithia.

The formula No. 2 was then tested in a similar way. This enamel has an extremely low calculated coefficient of expansion, namely, 231 x 10^{-7}, and it is also to be classified as a "hard" enamel. At the same time two differently smelted frits of the same composition were compared, one regularly smelted and one oversmelted. The results are shown in Table III.

From these results the unfavorable influence of oversmelting can be seen as well as the influence of lithium addition as a fluxing agent. Although the reflectance did not improve, better finish enamel resulted at a reduced burning time, and improvement in acid resistance was noted.

Linear thermal expansion curves were run on the interferometer**. Chart 3 shows enamel No. 2 (Table I.) regularly smelted "L", oversmelted "M", and including lithium silicate "S".

It is very interesting to compare the three curves. The linear thermal expansion data are also shown in Table III.

It can be seen from this table that over smelting apparently has a detrimental influence on the expansion. Lithium additions which help reduce smelting time and temperature decrease the softening temperature of the original enamel and also the thermal expansion.

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*These and all the following readings represent total thickness, including ground coat.

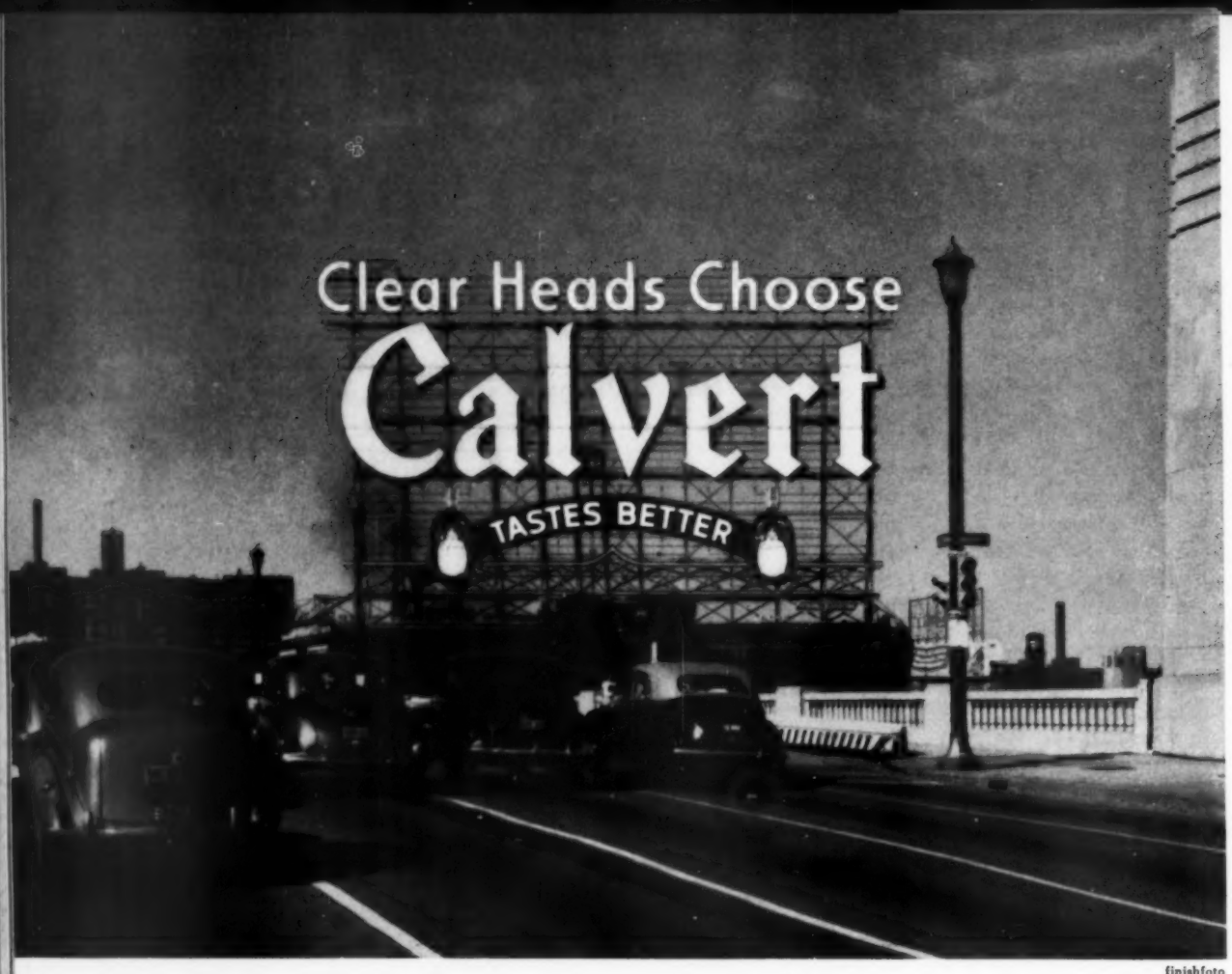
**By courtesy of Chicago Vitreous Enamel Product Co.

TABLE IV

Influence of Variations in Contents of Titania and Lithia

Content of Titanium Dioxide	Content of Lithium Metasilicate	Per cent reflectance Amber	Blue filter	Green
Burned at 1560° in 2¼ minutes				
a 10 %	1.5 %	71.–	69.4	71.2
b 12.5%	1.1 %	79.5	75.2	78.–
c 15 %	.75%	83.5	77.5	84.5
d 20 %	—	85	79.5	84.5
Burned at 1550° in 1¾ minutes				
a 10 %	1.5 %	70.2	70.	70.4
b 12.5	1.1 %	80	74.5	79
c 15 %	.75%	84	79.	82.3
d 20 %	—	Cannot be burned to a finish under these conditions.		

(Basic Enamel No. 1 — See Table I)



finishfoto

Ten thousand square feet of porcelain enamel in this spectacular

A NEW porcelain enameled spectacular is flashing its way to prominence on Chicago's Outer Drive near Randolph Street and Lake Michigan. Product of Federal Enterprises, Inc. (formerly Federal Electric Company, Inc.), of Chicago, this new advertising display for Calvert is outstanding in many respects. It is 114′ high, 210′ wide, and has an overall area of 23,940 sq. ft. The actual display area represents 10,000 sq. ft. of porcelain enameled metal.

Fifty-eight foot letters

Letters spelling the word "Calvert" are 58′ and 38′ in height. The heading, "Clear Heads Choose," is made up of 18′ and 12′ letters. "Tastes Better" reads in 8′ letters, and the bottle reproductions are 34′ x 17′.

142 sections in sign body

One hundred and forty-two sections comprise the sign body. Other interesting data pertaining to this new attention-getting spectacular include: 221 transformers, 1½ miles of tubing (in 1972 sections), 3944 electrodes, and 5 miles of wiring.

Current requirements total 12,600 KWH per month, or the estimated equivalent of one hundred and twenty-six 6-room homes. There are forty steps in the sign's flashing sequence.

There are 18 different porcelain enamel colors represented, dominated by the yellow in the word "Calvert."

This "small" display weighs 50 tons, has a steel structure weighing 120 tons, and reaches a height from ground to top of display of 220′—or the equivalent of an 18-story building.

This newest addition to Chicago's display of porcelain enameled spectaculars is proof again of the attention value, permanence and lasting beauty of porcelain enamel as a finish.

Cold rolled low carbon sheets

vs. enamel iron for high temperature enamels

By Don Beal • CERAMIC ENGINEER, THE YOUNGSTOWN SHEET AND TUBE COMPANY, YOUNGSTOWN, OHIO

Exclusive feature finish

Since considerable quantities of sheets other than enameling iron are being used for enameling purposes it might be of some interest to compare enamel iron with low carbon sheets and point out the differences in manufacturing procedure and characteristics of the sheets. Both enamel iron and low carbon sheets are made from rimmed steel. This is steel which is allowed to boil and effervesce in the ingot mold until the temperature drops to a point where the iron solidifies. Opposed to this is killed steel in which the boiling action in the ingot is reduced and controlled by the addition of a material such as aluminum or silicon added either to the ladle or to the ingot—thus the term—killed.

Basic differences in carbon and magnesium present

The principal basic differences in an enamel iron and a low carbon cold rolled sheet are the amounts of carbon and manganese present. A typical enamel iron analysis might be:

C	Mn	P	S
.03 max.	.10 max.	.01 max.	.03 max.

Cu	Tin	Ni
.08 max.	.01 max.	.08 max.

while a low carbon cold rolled analysis might be:

C	Mn	P	S
.03	.40 max.	.01 max.	.03 max.

Cu	Tin	Ni
.08 max.	.01 max.	.08 max.

Judged from the analysis alone, it might appear that the sheets would be only slightly different, but the difference in the analysis is only part of the difference in the finished sheet. These sheets must be processed differently from the open hearth to the final temper pass, and the enamel iron is more difficult to produce. A heat of enamel iron takes considerably longer to make in the open hearth. The extra time is necessary to reduce the carbon and manganese content to the allowable maximum. This is an added expense due to the increased time and higher temperature required to finish the heat. This last period of higher temperature is more destructive to the refractories than is any other period of heating.

Editor's Note:

In addition to presenting the basic differences between cold rolled low carbon sheets and enamel iron for high temperature enamels, this article also gives a running picture story of the production of special analysis steel.

Noticeable difference in hot rolling operation

The next noticeable difference between enamel iron and low carbon cold rolled comes in the hot rolling operation. Between 1700° F. and 1900° F., enamel iron is hot short and will crack if rolled between these temperatures. It is necessary, therefore, to roll at temperatures either above or below this range. The slabs are run through the break down rolls of the hot mill at temperatures above 1900° F. then held on the delay table and allowed to cool to about 1700° F. before they are started through the finishing rolls. The low carbon steel has no such critical rolling range.

The coils of enamel iron and low carbon steel are both fed through the same continuous pickler, then through the cold reduction mills and into the shear line where the sheets are cut to size. From this point on the operations are again different.

Enamel sheets need normalizing

The low carbon sheets can go directly to the annealing floor, but the enamel iron sheets must be given normalizing and pickling operations before they can be annealed. This is necessary in the case of enamel iron to refine the grain size. In the cold reducing operation the grain has been elongated till it takes on a lens-shaped form. A temperature of approximately 1750° F. is required to bring the grain back to the original less elongated shape. This normalizing is done in an oxidizing atmosphere, consequently scale is produced. A second pickle, usually of the batch type, is necsesary to remove the scale formed from the normalizing operation. The sheets are now ready to be annealed, but they have required two additional operations, normalizing and pickling, which the low carbon sheets did not require.

Heat above upper critical

It may be of interest to touch on the reason the enamel sheets require normalizing and the low carbon sheets do not. As the carbon and manganese content of the sheet decreases, the sheet does not respond readily to heat treatment and it is necessary to go above the upper critical to obtain the grain shape and size desired. The normal annealing temperatures of from 1300° F. to 1350° F. will refine the grain size of the low carbon sheets and while they were also elon-

1. *Special analysis steels—steels to tailor made specifications—are produced in open hearth furnaces. Specially selected cold scrap and limestone are charged into these furnaces and then reduced to a molten mass.*

2. *After the cold scrap and limestone are reduced to a molten mass, molten pig iron is added to the charge. Under normal operations about 55% of this charge is scrap, 10% limestone and 35% molten pig iron.*

gated from cold reduction they will regain their original shape at annealing temperatures.

Low carbon and enamel iron both given a temper pass

After annealing, both low carbon and enamel iron sheets are given a temper pass after which they are ready to be shipped. This operation is the same for both sheets, except that shot blasted rolls are used for enamel iron, this producing a rougher surface to promote bond between the ground coat and the steel.

It may be seen from the additional operations required that enamel iron is a more expensive and more difficult product to produce than is a low carbon cold rolled sheet. Also, the normalizing equipment is commonly a limiting factor in the production of enamel iron. If present normalizing equipment is being used at full capacity, it is doubtful that additional enamel iron will be produced in the near future because of the cost of installing additional normalizing furnaces and because the available steel, including enamel iron, must be divided as equitably as possible.

Difference in properties which affect enameling

Probably of most interest to the enameler is the difference in properties which affect the enameling. There are two outstanding differences in which the low carbon sheets do not measure up to the enamel iron sheets. The first is warpage. Due to the fact, as mentioned before, that enamel iron is less responsive to heat treatment, we find that it goes through less change at enameling temperatures

3. *After about 10 hours, the charge in the open hearth has been refined into high grade steel or enameling iron. The steel contents of the furnace is then tapped into a service ladle, while the slag flows into thimble on the left.*

4. *If necessary to eliminate gasses, aluminum or silicon is added to the heat of the steel. Then the ladle is removed from the open hearth furnace, and with the aid of huge cranes is taken to molds where the metal is cast into ingots.*

5. Steel ingots are first rolled into slabs on blooming mill, and then properly conditioned and transported to the hot continuous mill. The above illustration shows these slabs being rolled into flat rolled steel.

6. This photograph shows the four roughing stands of the hot continuous mill. The reduced slab is partially cooled on the run out table, immediately prior to its entrance in the No. 1 stand of the finishing mill.

and results in a much flatter enameled piece. Above annealing temperatures (1300°F. to 1350°F.) the low carbon sheets are likely to show considerable distortion.

Second difference is in finish produced

The second difference is in the quality of the enamel finish produced. Often a blistered enamel condition is encountered with cold rolled sheets which is not found when using enamel iron. This is probably due, at least in part, to inherent differences in the sheet. The carbon which is higher in cold rolled sheets is probably responsible for part of the blistering trouble. At enameling temperature the carbon breaks down into carbon dioxide which escapes through the surface of the enamel leaving a blistered surface.

The fact that cold rolled sheets are not normalized may also account for the fact that more blistering is encountered with their use. Since normalizing is carried out at temperatures above enameling temperatures any carbon near the surface is probably oxidized and driven off. Also, a scale is raised during normalizing which is later removed by pickling. This insures a cleaner surface on a normalized, pickled sheet than on one which is not so treated.

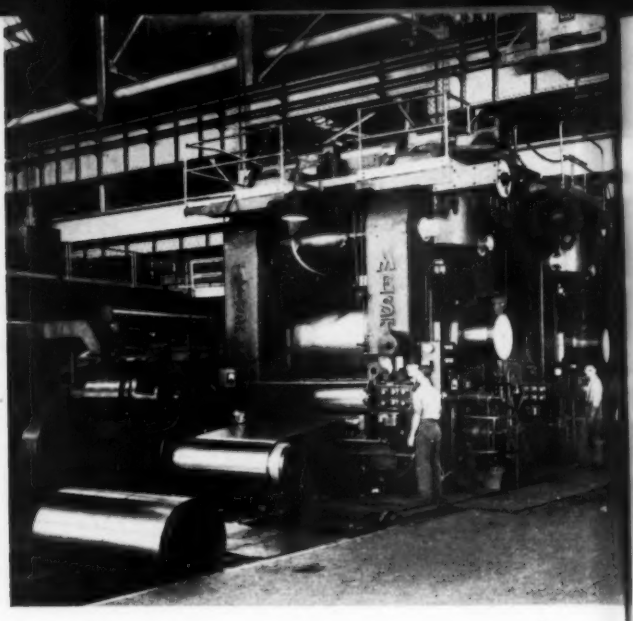
Other factors which affect cold rolled sheets

There are several other factors which make it more difficult to enamel cold rolled sheets successfully. Cleaning a cold rolled sheet is usually more difficult than cleaning enamel iron due to the fact that enamel iron

7. The finishing section of the hot continuous mill consists of six stands of rolls. Each stand revolves just enough faster than preceding one in order to compensate for the elongation which occurs in preceding stand.

8. A strip of steel or enameling iron is shown on conveyor table immediately after it has emerged from the last finishing stand of the finishing mill. Some of these strips are as long as 1400 feet, depending upon the gage being rolled.

9. *Steel from hot continuous mill is delivered in coils to continuous pickler where dirt, grease and mill scale are removed from both surfaces of the material. At exit end of pickler, material is recoiled preparatory to cold reduction.*



10. *After pickling, the material is delivered to cold reduction mill where it is cold reduced to proper gage. Illustrated is a 4 high, 3 stand cold mill. Immediately to the left of this unit is a 4 stand, 4 high cold mill comparable in type.*

is shipped dry and most cold rolled sheets are oiled for rust prevention before they leave the mill. The oil used is a mineral oil and is difficult to remove in an alkaline cleaner. For this reason more care is necessary while sheets or parts are being cleaned.

Cold rolled sheet surface is smoother

Since the cold rolled sheet is finished with bright rolls the surface is smoother than an enamel iron sheet. Because of this a nickel dip is advisable to promote bond since it is not good practice to pickle a cold rolled sheet long enough to produce a rough surface. Also the rate of surface oxidation varies more during enamel firing in cold rolled sheets and a nickel dip is desirable to control this oxidation rate.

A closely controlled pickle is very necessary when processing cold rolled sheets due to the fact that the activity in the acid will vary with different lots of steel. The pickling time should be kept at a minimum as a carbon smudge is apt to appear if the sheets are pickled too long. If this occurs the only way to remove the smudge is to wipe it off, which is a long and difficult operation.

Extra precautions when enameling cold rolled sheets

It is seen that extra precautions must be taken when enameling cold rolled sheets to produce an acceptable product. The problems of the enamel plant superintendent will be decidedly reduced when the demand for enamel sheets drops to the point where adequate tonnages are again available.

11. *After the material has gone through the pickling procedure, and has been cold rolled, it is then sheared to the proper width and length. It is then annealed in order to instill in it the necessary required ductility.*

12. *After pickling, cold rolling, normalizing and annealing, the material is given a temper pass on large mill shown below. Then after the flat rolled sheets have gone through roller leveling machine, they are ready for delivery to customer.*

Product improvement

through the use of porcelain enamel

By Horace R. Whittier • PRESIDENT, THE HORACE R. WHITTIER CO., PEQUABUCK, CONN.

Exclusive feature finish

The layman associates the use of porcelain enamel in most instances to large items such as bathtubs, refrigerators, stoves, etc. The use of porcelain enamel for small items in the past has been principally for small watch dials, clocks, meter dials and other purposes where exquisite fine figures and a beautiful finish are paramount.

Porcelain enamel watch dials, as used on railroad watches and other fine instruments, are usually enameled on copper and use a different type of enamel than used on larger household and commercial products. Porcelain enamels are also used in exquisite jewelry work, such as cloisonné. These fine enamels naturally have a somewhat limited market due to the high cost of production. However, this type of work is everlasting and beautiful, as evidenced by the works that can be seen in many museums throughout the world.

An "in between" market

Between the exquisite enameling required for jewelry products and the use of porcelain enamel in large signs, refrigerators, etc., there is a zone of activity that has been sadly neglected by the conventionally trained engineer of today. This lack of knowledge on the part of those responsible for design and new products in many companies is rather a pathetic commentary on the porcelain enameling industry. One regret is that common usage by paint manufacturers of the word "enamel" for paint products has put into the minds of most engineers and purchasing agents the fact that enamel constitutes a hard-baked finish, such as the enamel that is used on bicycles or similar items. In the old days "enamel" had only one definition — material which we call "porcelain enamel" today. The confusion in terminology has brought about an indifference as to what constitutes a porcelain enamel product.

The Whittier Company, in building up its business, has concentrated on certain items and has convinced a number of manufacturers of the desirability of substituting a porcelain enamel finish in place of synthetic paint enamel or an etched dial. In all instances when these changes have been made, the customer has been so well pleased with the results obtained, even at a higher price, they have remained loyal customers. Telephone manufacturers requiring dials for telephones realize a porcelain dial is the best dial — in fact, the only dial that will withstand the rough usage and the corrosive effect of acid in their finger manipulated mechanism. To save money, one large telephone company used a synthetic enamel paint and today many of these dials are yellow stained and, in many instances, the figures have worn off, necessitating frequent renewals. So, we are happy to say the large manufacturers together with the independents have specified a porcelain dial for their telephones.

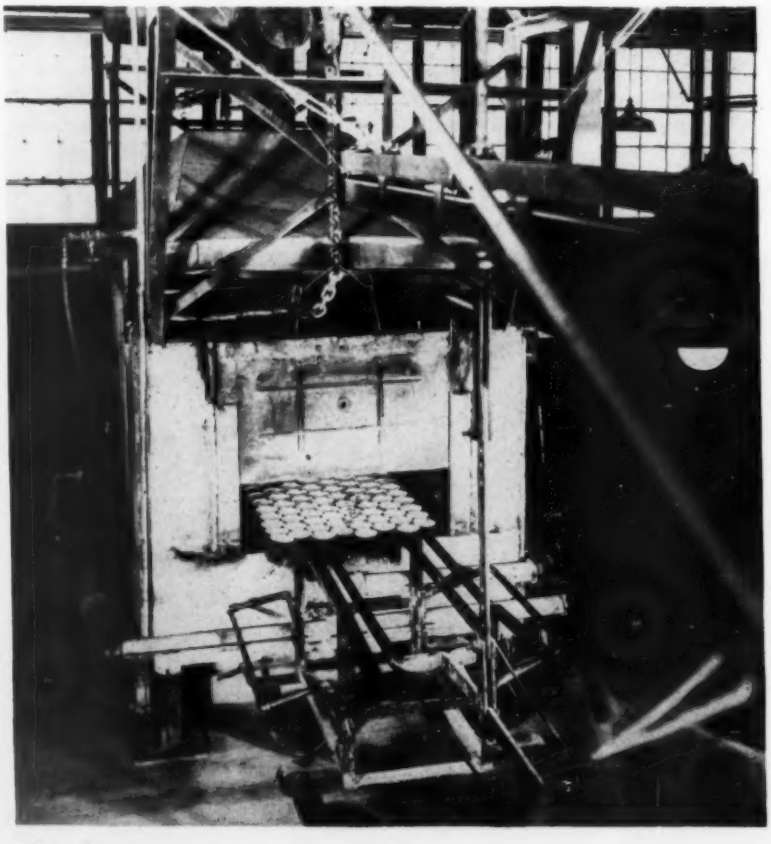
Meter manufacturers, both gas and water, have used porcelain dials for many years in the past, and their experience in the use of substitute plastic and others has proved rather disappointing. They have found that nothing is saved in looking for a cheap substitute for a porcelain dial.

During long years of manufacturing experience, our company has de-

This photograph shows the wide variety of small parts which can be logically enameled in a plant designed for this type of work.

In the Whittier plant at Pequabuck, Conn., small parts are placed close together on wire "trays" for spraying.

This double end gas-fired furnace is equipped with a speed fork which is suspended from an overhead track.



veloped certain techniques of production that have put porcelain enamel practically on a direct competitive basis with other types of material such as etched dials, plastics, and other less durable products.

Three methods of reproducing printing

We have used three methods of producing printed matter: silk screen, brush-out stencils, and offset printing using hand-operated presses. These hand presses are extremely efficient and produce high quality results at a fairly high production rate. High speed printing methods can be used on porcelain enamel, but the results are not always high quality. Therefore, we feel that the slower method of hand printing, giving superfine results, more than compensates for the slight increase in production that can be gained by the use of printing presses.

In our method of printing we can print double, triple and sometimes four engravings on small dials. Using a positive impression engraved on steel, we pick this up out of the dies by printing pads and these in turn are transferred onto the item to be printed, giving an offset printing result that is extremely pleasing. For permanency the lettering is fired into the enamel under high heat, which gives a very brilliant glossy effect. The effect is similar to decorated ceramics or dinnerware.

The silk screen method produces very fine detail on larger work. By that we mean dials possibly 3″ to 4″ in diameter, where a heavy background and multiple colored effects is sometimes required. A silk screen is employed for each color. In producing the still larger signs, we use the long established method of paper or zinc stencils using two stencils for a complete figure, one of the stencils brushing out the tie-ins.

Furnace equipment

The furnace equipment used in our plant is unique in design, having doors at both ends. The manipulation of the doors and the speed forks is very simple. The forks are suspended from overhead tracks, very delicately

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American Gas Association

holds thirtieth annual meeting

gas appliance manufacturers stage outstanding exhibition

THE Boardwalk at Atlantic City swarmed with representatives of all phases of gas industry during the week of October 3. The thousands in attendance included all branches of the industry, and sections of the program were designed to meet the specific needs and interests of those representing natural, manufacturered, and LP gases.

One of the finest exhibitions of gas appliances, components and gas industry equipment ever to be staged in the Atlantic City Auditorium was sponsored by the Gas Appliance Manufacturers Association in conjunction with the American Gas Association convention.

In the interests of dealer cooperation, a combined AGA-GAMA-Dealer meeting was staged on Thursday, October 7.

The ladies came in for their part of the program through such activities as the Home Service Round Table, attended by leading Home Service directors, and the Home Service Breakfast at which honored guests were introduced by Miss Elizabeth J. Lynahan, chairman of the AGA Home Service Committee.

Hendee new AGA president

Robert W. Hendee, president of Colorado Interstate Gas Company, is the incoming AGA president. Mr. Hendee has, for the past two years, been chairman of the Natural Gas Department.

AGA President, Robert W. Hendee

National fuel policy urged

At the opening general session on Tuesday morning, Hudson W. Reed, retiring AGA president, and president of the Philadelphia Gas Works Company, urged the establishment of a national fuel policy under which all types of fuel could be satisfactorily regulated. Mr. Reed pointed out that we have a foreseeable supply of bituminous coal for a thousand years. Oil reserves will last for a much shorter period, though they may be supplemented by imports. Proved natural gas reserves are encouraging, but should be protected. He voiced a challenge to the fuel industries to develop a practical, workable program for the conservation of these natural resources. He said, ". . . it

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GAMA Photos . . . Pages 32 & 33

View of exhibition of gas appliances staged in Atlantic City Auditorium by Gas Appliance Manufacturers Association.

The GAMA organization for the coming year

the men shown on these two pages will lead manufacturers in their greatest year of activity in the production, promotion and sales of gas appliances

President, Frank J. Nugent, Bryant Heater Company

1st Vice Pres., Stanley H. Hobson, Geo. D. Roper Corporation

2nd Vice Pres., Frederic O. Hess, Selas Corporation of America

Treasurer, John Van Norden, American Meter Company

Managing Director, H. Leigh Whitelaw, GAMA

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Gas Furnace, Keith T. Davis, Bryant Heater Co.

Controls & Accessories, J. A. Wolff, Milwaukee Gas Specialty

Air Conditioning, John K. Knighton, Servel, Inc.

Gas Meter & Regulator, A. F. Benson, American Meter Co.

Gas Water Heater, Leland W. Feigel, Servel, Inc.

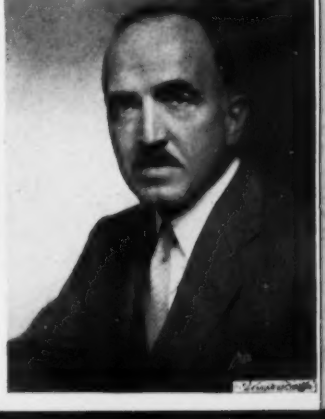
Gas Valve, Philip S. Harper, Harper-Wyman Co.

Gas Boiler, C. L. Hewitt, Jr., L. J. Mueller Furnace Co.

Gas Conversion Burner, E. A. Norman, Jr., Norman Products

Industrial Gas Equip., Alvin M. Stock, Partlow Corp.

Restaurant & Commercial Gas, W. H. Rudolph, Savory Equip.



→ *from Page 31*

should be possible to develop and coordinate a long-range fuel plan, which not only would be beneficial on a national basis, but would conserve and stabilize the use of the nation's remaining natural resources. No other country in the world was originally as well endowed in fuel resources. As our industrial development is geared to these plentiful supplies, it behooves us to protect these resources so that our national economy will not be crippled within the next generation or two."

He said the largest number of customers in the gas industry's history —21.4 million customers—is presently supplied by utilities. Of these, about 19 million are residential. About 5 million additional customers are served by the fast growing LP-gas industry.

Mr. Reed was strongly complimentary to the manufacturers of gas appliances and equipment, who, he said, have an organization that is unifying and perpetuating their own interests as well as those of the gas industry and the public.

Return of "service" needed

B. H. Wittmann, manager, domestic sales, The Peoples Gas Light and Coke Company, Chicago, voiced the opinion that creative salesmanship has been all but completely stiffled by the continuing period of consumer goods shortages. Far more serious, he feels, is the deterioration of the fundamental idea that the salesman's time and effort is dedicated to services for his prospect and customer. Too many sales people have developed a feeling of superiority and smugness in dealing with customers and prospects. This results in a lackadaisical approach to the problem of customer relationship. The immediate need in industry, particularly in sales departments, Mr. Wittmann feels, is to revive and intensify the national concept of service. This need should and can be served *now* with simple and positive methods.

Clear skies

John A. Robertshaw, president of Robertshaw-Fulton Controls Company, and retiring president of GAMA, spoke before the opening session under the title, "Clearing Skies." He pointed to the results from close cooperation between AGA and GAMA as compared to conditions approximately 14 years ago, when the Gas Appliance and Equipment Manufacturers were the "largest unorganized industry in the United States." An understanding achieved in no other industry has grown out of participation in joint projects by members of both associations, he said.

Mr. Robertshaw feels that we are emerging slowly from a period of hesitancy and fear induced by the post-war hangover of experimental philosophies and economic indecision, and the business climate is shifting from one of inertia to one of initiative.

"Manufacturers everywhere in the gas appliance and equipment field," said the speaker, "are hopeful of clearing skies, apparently, for they are increasing their promotion and advertising efforts to pave the way for the time when adequate supply in all of our lines will multiply competition in the home equipment field."

In referring specifically to forceful advertising and sales campaigns, Mr. Robertshaw mentioned 1949 plans of the water heater manufacturers, GAMA's range advertising programs included the "CP" campaign, etc. In outlining appliance sales progress, he referred to estimates of range production reaching 2,800,000 units for the year 1948—the largest in the industry's history. A little over ¼ of total range shipments during the first six months of the year were for LP-gas.

In closing, he said, "With the return of an adequate supply of products, stepped-up competition, and promotional efforts from other fields, the very best sales efforts and sales imagination of gas companies is needed . . . ."

Sorby speaks at dealer meeting

E. Carl Sorby, vice president of Geo. D. Roper Corporation, Rockford, Illinois, was featured in a talk before the dealer meeting on Thursday, October 7, in which he discussed the advantages of cooperation versus competition. He pointed to the need for unity of effort, the imparting of knowledge and assimilation of information that would be helpful to all those participating in cooperative effort. He carried his reasoning in support of cooperation from individuals, such as salesmen, engineers, accountants, assemblers and shippers, to top management and complete industries.

As an introduction to his talk, Mr. Sorby presented a colorfully dramatized preface which included costume, lighting effects and organ music. The following bit from his presentation seems sound advice for any reader:

"A smile costs nothing, but it gives much. It enriches those who receive it without making poorer those who give it. It takes but a moment, but the memory of it sometimes lasts forever. No one is so rich or mighty that he can get along without it, and no one is so poor but what he can be made richer by it. A smile creates happiness in the home, fosters goodwill in business, and is the countersign of friendship. It brings rest to the weary, cheer to the discouraged, sunshine to the sad, and it is nature's best antidote for trouble. Yet it can not be bought, borrowed begged or stolen, for it is something that is of no value to anyone until it is given away. Some people are too tired to give you a smile. Give them one of yours, as no one needs a smile so much as he who has no smile to give."

Nugent heads manufacturers

Frank J. Nugent, sales promotion manager of the Bryant Heater Company, Cleveland, Ohio, was installed as new president of GAMA, succeeding John A. Robertshaw, and opened the largest exhibition of gas appliances and allied equipment which has been held.

Other new officers installed, as announced by H. Leigh Whitelaw, managing director of the Association, were: first vice president, Stanley H. Hobson, president of Geo. D. Roper Corporation, Rockford, Illinois; second vice president, Frederic O. Hess, president of Selas Corporation of America, Philadelphia, Pa.; and trea-

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Porcelain enamel mural

dedicated at Kansas Free Fair

reproduction of famous war photograph contains 144 square feet of architectural porcelain enamel panels

ON the opening day of this year's Kansas Free Fair, at Topeka, an 8-color porcelain enameled mural showing the raising of the American flag on Mount Suribachi, Iwo Jima, was dedicated. The 12 x 12 foot reproduction is said to be one of the largest porcelain enameled jobs ever produced with stencils.

The mural was placed on the front of a 68′ 3″ high all-porcelain enamel pylon erected at the entrance of the fair grounds. The tower was constructed around a structural steel frame to which were fastened vertical 2 x 6 furring strips, which in turn support horizontal 2 x 3 furring strips. Then 28″ x 36″ architectural porcelain enameled panels, supplied by Davidson Enamel Products, Inc., Lima, Ohio, were applied on the horizontal furring.

Large flood lights around the top of the pylon illuminate the top fluted portion while flood lights from the ground illuminate the lower portion. The whole tower is a light yellow with red letters reading "Kansas Free Fair" running vertically on two opposite sides of the tower. The back side, facing the fair grounds, is plain; the front, facing the highway, has the mural.

Production of the mural

The first step in the production of the mural was to make a colored sketch 30″ x 30″, showing the necessary simplification required for stencil reproduction. The sketch was sent to Topeka, Kansas, where Ray Anderson, constructor, submitted it to the Free Fair board and architects for approval.

The approved sketch was returned to Lima where full-size stencils were made, and the colors on the sketch matched in porcelain enamel. The colors are as follows:

Background ..... blue-gray
Marine uniforms...jungle-green
Marine jackets and parts of rocks .....gray
Flag pole, marines' guns, and belts .....gray
American flag ....red, white and blue
Outline and shadows.....black

Colors in the individual panels range from only one to eight, while most panels have five colors. It was necessary to fire all the panels the same number of times as the background color showed on all the panels.

Inspection of the finished mural was accomplished in the plant by laying the 20 panels on the factory floor where they were viewed from a high platform. This was a check on any

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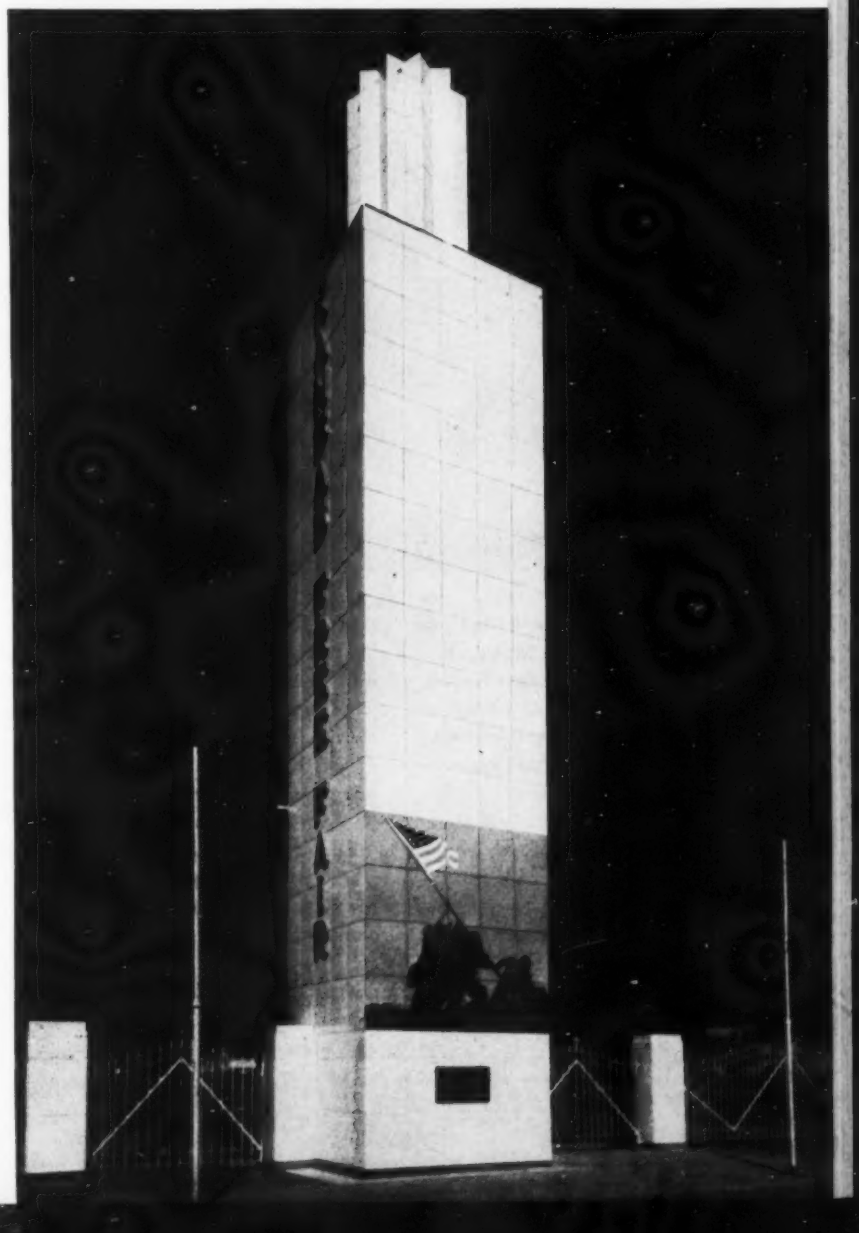


PORCELAIN ENAMEL I

the tenth annual forum for plant me

THE 10th Annual Porcelain Enamel Institute Forum for plant men, held at the University of Illinois, October 13, 14 and 15, drew a record attendance of key enamel plant men. Three days of perfect autumn weather prevailed throughout the forum.

The program contained a wealth of papers on practical subjects of vital interest to industry men. The subjects included panel discussions on titanium enamels and on the application of cover coats directly on steel, quality control, control of industrial wastes, personnel safety, budgeting expenses, and government research projects on ceramic coatings.

Following registration on Wednesday morning, October 13, Dr. A. I. Andrews, Head of the U. of I. Department of Ceramic Engineering, presided at the opening session in the afternoon.

The address of welcome was presented by M. L. Enger, Dean of the College of Engineering, with the response by C. D. Clawson, President of the PEI. Dean Enger stated that it was a pleasure to have "this growing forum" meet on the Illinois campus. President Clawson added to Dean Enger's statement when he announced that there was a 50 per cent increase in the membership of the PEI during the past 12 months.

Edward Mackasek, Managing Director of the Institute, presented a review of activities of various PEI committees. He stated that the porcelain enamel industry must "go out and promote the market" by extolling the virtues of porcelain enamel.

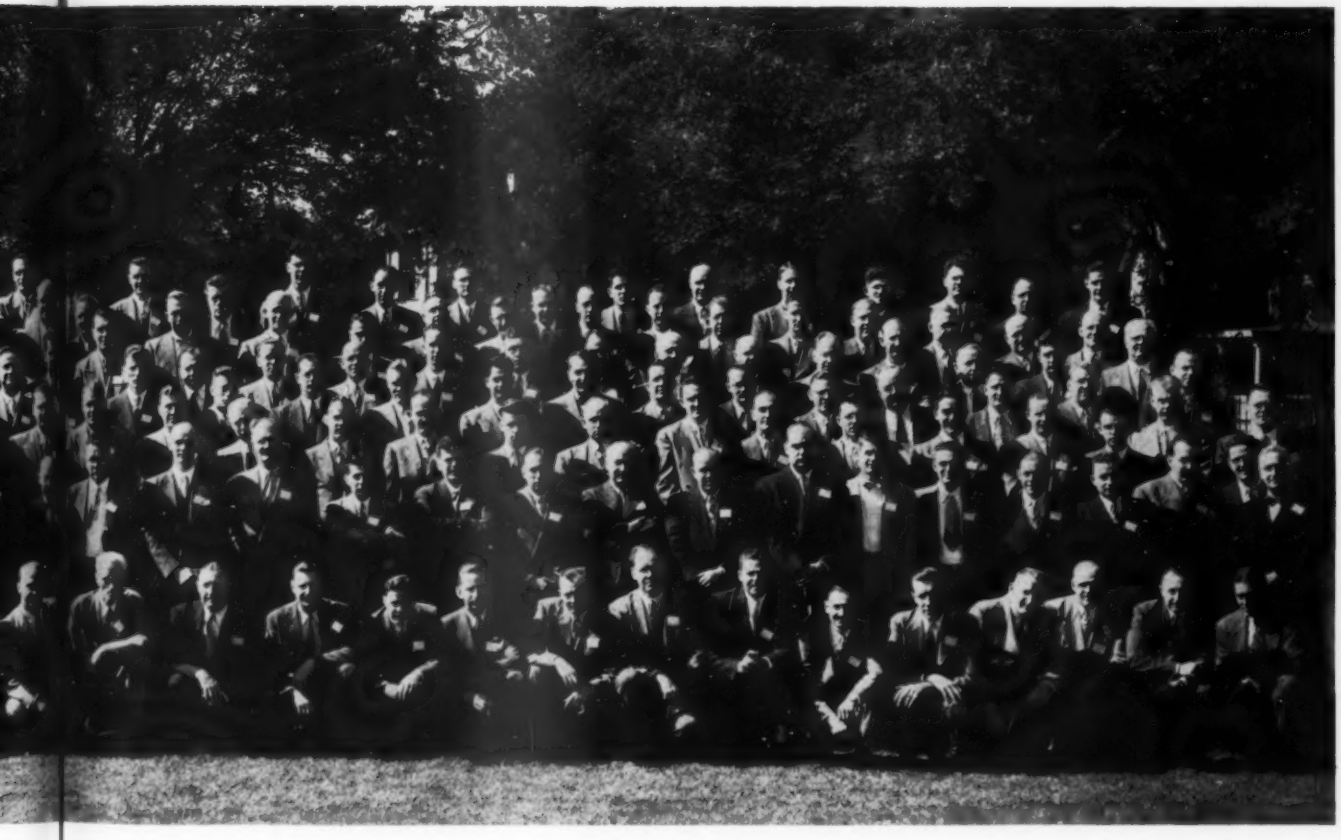
Wednesday's formal program, presided over by Dr. A. I. Andrews, consisted of a panel discussion of titanium enamels, with the following papers presented: "Review of Titanium Enamel Development and Discussion of its General Properties," By D. R. Goetchius, Ferro Enamel Corp., and "Application of Titanium Enamels," By Harold Wilson, Vitreous Steel Products Co.

Panel discussion

The second session, on Thursday morning, was presided over by Dr. J. J. Canfield, Armco Steel Corp. It was also a panel discussion — on the application of cover coats directly on steel — with the program divided

EL INSTITUTE FORUM

ant men held at University of Illinois



into three parts, special steels, 1500° enamels, and 1300° enamels. Frank Porter, Inland Steel Co., opened the program with a discussion of "Special Steels and Preparation for Enameling." Then the following papers on 1500° F. type of enamels were presented: "Shop Processing of Titanium Enamels Direct to Titanium Steel," by John Lannan, Westinghouse Electric Corp.; "Pickle and Millroom Practice and Procedure for Application of Titanium Enamel Direct to Titanium Steels," by John C. Swartz, Westinghouse; and "Zirconium and other Types," by M. E. McHardy, Hussmann Refrigerator Co. B. D. Bruce, Chicago Vitreous Enamel Product Co., then presented his paper on "1300° F. Enamels, One and Two Coats."

Presiding at Thursday afternoon's session was Dana Chase, editor and publisher of *finish*. Control of various factors involved in enamel plant operation were discussed by the panel which included Waldo Higgins, A. O. Smith Corp. — "Quality Control of Manufactured Product through Incentives;" H. S. Kline, Frigidaire Division, General Motors — "Control of Liquid and Airborne Wastes from Porcelain Enameling;" Russell Frank, Ferro Enamel Corp. — "Personnel Safety and Health Hazards in the Enamel Plant;" and Charles Pearce, American Ceramic Society— "Budgeting Expenses in the Enamel Plant."

Profit sharing plan

At the forum's excellent banquet, Thursday evening at the Urbana-Lincoln Hotel, Dr. G. H. McIntyre, Ferro Enamel Corp., introduced R. R. Trubey, Baltimore Porcelain Steel Corp., who spoke on "Private Enterprise, Profit Sharing and Savings Plan."

At the opening of his address, Trubey lamented that since 1914 this country has lived in an economy based on "rebuilding after destruction." The wealth derived from this "rebuilding" was never saved; if some of it had been laid away for the benefit of the lower income groups, then the depression of the early 1930's probably wouldn't have been so severe.

There never can be over produc-

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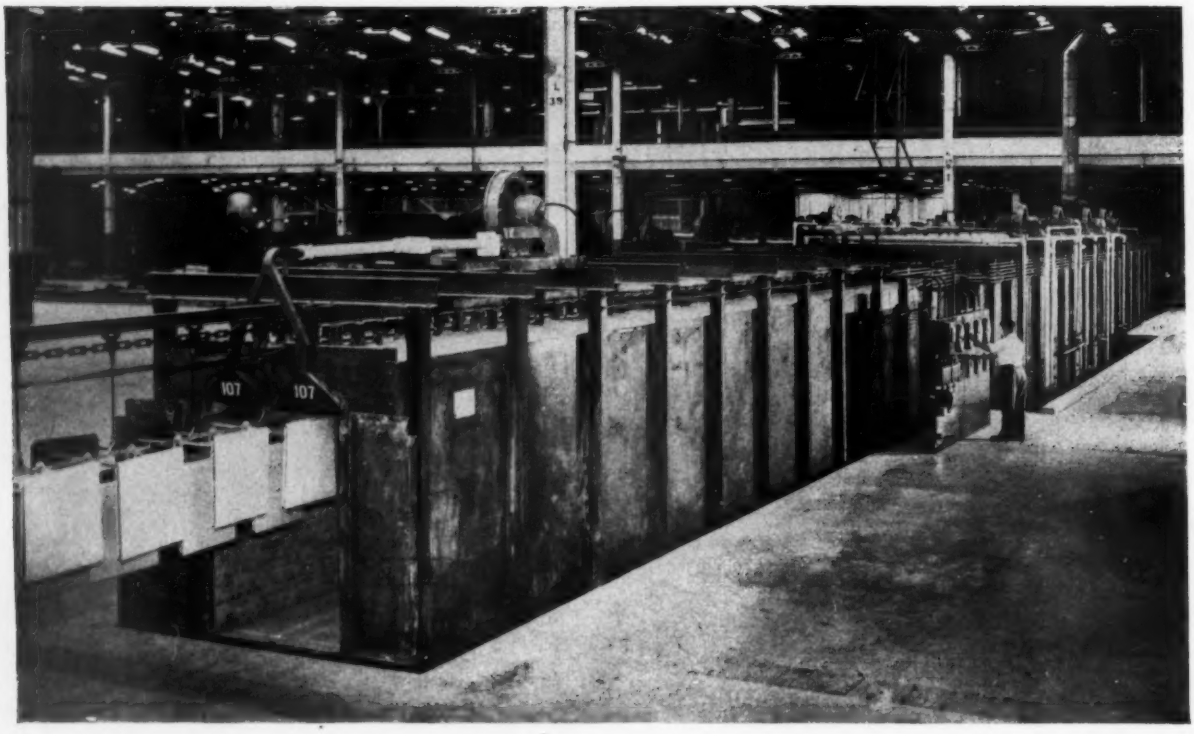
The World's Largest



by BOLAND

This is the first of nine Boland STRAIGHT AWAY—SINGLE FLOW continuous furnaces to get into production at the new LUSTRON plant in Columbus, Ohio. All of these furnaces, together with two electrically heated furnaces by another builder, have the famous Boland FLOATING ROOF construction. All in all, this represents the completion of THE WORLD'S LARGEST PORCELAIN ENAMELING FURNACE INSTALLATION—completed in record time by Boland.

ALBERT J. BOLAND COMPANY

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Designers and Builders of Continuous and Box Type Enameling Furnaces

Tenth annual forum program report

with excerpts from complete papers

The application of cover coats directly on steel

By M. E. McHardy

The introduction of titanium steel has been a big step forward towards solving the industry's goal of reducing warpage, enamel thickness and process defects.

History of the progress concerning this report started in June, 1945, when a field production run was conducted, applying cover coat enamels directly on the base metal. The results of the trial run were promising and indicated that titanium steels had production possibilities in the plant, were satisfactory for direct cover coat application, and would also help to further the development of new methods of processing in the porcelain enamel field. It was felt that the interesting properties of titanium steels might lend themselves to the production of interior liners for reach-in type refrigerators, and also at the same time help solve a production problem. Warping of open flanges had been a problem in the production of large liner sections; however, the sag resisting properties of titanium steels have helped solve this problem as they are beneficial in keeping open flanges straight during and after firing.

Production of one coat, one fire interior liners was started early in 1946, using 18 gauge titanium steel and zirconium cover coat enamel.

The production at first was limited to interior parts only, but experience gained from the production of interior liners has led to the development and use of titanium steel interior and exterior parts for commercial counter type cases. Interior parts are processed one coat, one fire while the exterior parts, as a matter of exterior quality and size also being a factor, are presently being processed in two coats. A solid second coat of antimony-bearing acid resisting enamel is applied to the exterior top panels.

Parts designed and fabricated of titanium steels are blended in with regular ground coat production; however, certain control specifications have been developed to process parts fabricated from titanium steels.

The use of titanium enamel applied directly to the base metal as a one coat, one fire acid resisting finish has been limited to experimental stages only, but some one coat exterior panels have been successfully produced at a fired thickness of .004 - .006.

Production methods

Titanium steels do require careful control during the various stages of processing. In order to take advantage of the properties of the steel to produce quality ware exhibiting good adherence, lower cost and reduced enamel thickness, control procedures should not vary. Procedures through all departments should be as follows:

1. Sheet metal department must exercise careful handling during receiving, stacking and fabricating to avoid surface scratches as the results are very difficult to cover. Punches and dies should be kept sharp to prevent burred holes and shears should leave clean edges.

2. All parts fabricated from titanium steels should be inspected for surface scratches, and any burrs stoned down prior to pickling. Drawn parts should be wiped with solvent to improve cleaning.

3. Cleaning must be very thorough. Where oils or drawing compounds are used in drawing or forming and the parts allowed to stand before processing, a slight rusting may take place. Although the rust may be removed during pickling, the oil film underneath may not be completely removed causing adherence problems later on.

4. Tests have shown that acid pickling time can be held to a minimum and does not have too great an effect on adherence.

5. It has been found that nickel deposition ranging from .050 to .100 grams per square foot (preferably .080 to .100) is necessary to promote adherence.

6. Flatware appearing clean is dry wiped and air dusted prior to spraying. Ware showing any unusual surface condition is wet wiped, dryed, sanded, and dry wiped. All ware is again inspected for surface scratches.

Due to the sinking and handling problems encountered with the box

Pickle Room Cycle

Tank	Concentration	Temperature	Time
Cleaner	7-8 ounces gallon	Boiling	15-30 Min.
Cleaner rinse	Fresh water surface skimmer	Warm	Work load well
Sulphuric acid	6% - 8%	140°-150° F.	5-8 Min.
Acid rinse	Fresh water surface skimmer	Cold	Work load well
Nickel, single	1½ ounces gallon PH 3.0 - 4.0	160°-170° F.	15 Min.
Neutralizer	Na_2O .3% - .4% NaOH .45 ounces gallon NaCN .20 ounces gallon Borax .20 ounces gallon	120°-130° F.	3-5 Min.

shaped liners during pickling, the finished surfaces are washed with water, dried, and seams blown out with air pressure. Stains are sanded and the finished surface dry wiped prior to spraying.

7. Ware showing brown or black specking after firing is covered with a light rework or second coat.

8. Slight surface cracks or strains sometimes found over drawn corners may cause the enamel to tear and peal back after firing, exposing oxidized metal. Grinding off the rolled edge without greatly disturbing the oxidized metal and applying a light spray over the defective area appears to give the best rework or salvage results. Rework ware can be fired at lower temperature than the original first coat fire.

9. Airborne dirt, grit, and effects of scratched surfaces will destroy any attempt at a uniform and thinner coating.

Pickling process is of the batch type and production to date has been accomplished with only one alkaline cleaner tank serving all purposes.

It is felt that a light borax rinse after the cyanide neutralizer would be beneficial in reducing neutralizer stains and the effects of iron and nickel salts.

Booth reclaim is used on the back sides of all ware, the face sides of interior ware, and as much as possible as a first coat on the face sides of exterior ware.

The face sides of interior liners are sprayed with a 50-50 blend of new and reclaim cover coat to obtain a fired thickness of .005 - .007.

One hundred per cent booth reclaim is used on one coat interior flatware to obtain a fired thickness normally between .005 - .006.

New zirconium enamel is used as a second coat on exterior ware with the exception of exterior top panels where antimony-bearing acid resisting enamel is used as a solid second coat. The fired thickness on exterior two coat ware is normally between .008 - .010.

Firing is accomplished on radiant tube box type furnaces using temperatures ranging from 1550° to 1570° F., with time cycles based on furnace comeback. It is very important that the first bisque coat be completely dry before firing. Rework and touch up ware can be fired up to 30° F. lower than the first fire.

When production of one coat, one fire ware was first started, the fired surface exhibited a slight pitted effect, but since that time the development and control of all operations has produced in most cases a very satisfactory finish using zirconium cover coat enamels.

Antimony-bearing acid resisting enamels were tried as a one coat application on the face surface of interior liners, but apparently due to the fluidity of the enamels, the liners, after firing, exhibited white hairlines from strain and pronounced the surface lines on the metal. The texture of the fired surface was very satisfactory.

The introduction of such a metal or any new change in enamel processing to accomplish the ultimate goal in the enamel field to produce a lasting finish with fewer process defects, reduced thickness, and at a lower cost, certainly requires close cooperation and interest among all parties concerned. Straight line production using titanium steels might warrant changes in equipment and processing methods to eventually produce a very competitive finish.

Personnel safety and health hazards in the porcelain enamel plant

By Russell Frank

To discuss personnel safety and health hazards in the modern operation of a porcelain enameling shop, operations must first be classified into the following four parts:

1. Handling, sizing, shaping steel for coating with porcelain enamel.
2. Cleaning the semi-processed material.
3. The application of the frit, and firing.
4. The handling for assembly and shipping.

The most trouble would occur in the first and fourth divisions. The frequency and severity of injuries from these operations are much higher than in the work of applying the finish, or division two and three.

To view the complete picture of any porcelain enameling operation, one would find lacerations from sharp edges of steel occurring with high frequency, with new employees sometimes receiving from one to eight cuts each day. Abrasions and contusions run a close second from the standpoint of frequency. Of high incidence would be back strains; injuries from presses, shears, brakes and conveyors prove to be the most severe.

Turning to parts two and three, the cleaning and coating phases, one would find lacerations from the edge of the ware were most frequent. These occur during brushing, handling, dipping and spraying. The next cause of injuries from the standpoint of frequency is in the handling of hot ware. Burns received from this work are very hard to heal. This is reported to be the case if the plant permits too much dust to be present. Occasional cases of dermatitis, acid and alkali burns, foreign bodies in eyes, glass slivers, back strains, muscular fatigue, electrocution, and miscellaneous complaints may be blamed upon general dust.

Injuries can be eliminated or minimized by proper personal protective devices. Teaching correct work methods will control others.

Recent developments showing the need for plant cleanliness or "controlled atmosphere" for quality finish will probably do much to eliminate any dust or fume condition likely to create a problem.

There are a few recognized hazards, with others to be measured and evaluated in the future. The most important would be free silica. The enamel shop would find this in the mill additions exclusively. Frit does

not contain free silica. At this time porcelain enamel cannot be identified as being hazardous beyond the nuisance value given all dust.

Lead, antimony, certain color oxides, acid and alkali fumes, oxides of nitrates, carbon monoxide, fuel gas and fluorine present known hazards. Their use is either in minor amounts or they occur at a phase of the operations, which, if correctly controlled, are not dispersed in heavy enough concentrations to be a concern. They must not be ignored because abnormal temporary operations might be such as to permit over-exposure and harm.

The safe use of new chemicals in new enamels and substitutes for items in short supply must be continually studied.

Of great importance in the mill room and pickling room are electric controls. Where voltage is 200 volts and up, or even 110 if absolute safety is wanted, there should be low voltage switches to energize and activate the more dangerous power circuits. Wet floors are natural settings for an electrocution.

Concerning the safe operation of the furnace, designs are always being revised to include the latest in safety and efficiency. In outline, the erectors instructions should be followed in detail. Ventilation and supply must be right, calling for skilled installation and no careless tampering or amateur adjusting.

The furnaces are intermittent, batch or continuous type and usually operate at or near 1600° F. This indicates the need for common sense conduct in maintenance if serious burns are to be prevented. Many continuous furnaces are designed with "cooling booths," making the ware safer to handle.

Concerning lubrication and maintenance of hot units in production, new types of lubrication systems are available. Other changes and improvements in design will further reduce the need for extreme exposure of employees on top of a hot unit.

Burners should be equipped with approved safe controls interlinking power, fuel, ignition, draft and perhaps ventilation.

When lighting a "cold" unit, a fire must be built and allowed to burn for 60 minutes inside the base of the stack. Without this artificial acceleration of the "stacking effect," rapid combustion of a fuel pocket can occur and damage the unit and/or injure workmen.

Electric furnaces require approved design switch panels, enclosed and insulated according to standard practices for the proper voltage. The power supply should be interconnected with auxiliary safeguards and equipment to assure safe operations.

If propane, butane or natural gas is used for fuel and burners are in a pit or below floor level, this area must be ventilated to remove the possibility of trouble. An explosion could occur if the fuel happens to be heavier than air. Some units are designed to use propane in the event of other fuel shortage. Under certain conditions, maintenance personnel might be exposed to harmful fumes while working in these pits.

The pickle room calls for good design, correct location, first class supervision, and ventilation of the most dependable type.

Acid and alkali fumes are harmful to human tissues. The fumes cause poor quality ware in other parts of the plant. Their presence in the other departments require careful searching to discover and account for. In some cases these fumes can be a fire and explosion hazard.

Other considerations in pickle rooms are inspection and maintenance of hoisting apparatus. Aisles and walkways must be clean and free from obstructions. If open tanks are used, they should have a 30-inch high barrier guarding their edge, or the top of the tank 30 inches higher than the surface provided for the worker to stand upon while servicing the tank.

The room and contents should be regularly inspected for excessive corrosion and weakening of equipment and structures. Strong acids, alkalis and cyanide should be under lock and key, with the key issued to only one or two responsible persons.

Enamel sprayers wearing air line helmets are provided with clean filtered air at rate of 6 cubic feet per minute.

Modern methods are available for handling and dispensing chemicals. They are easily adaptable to old and new installations. At least use hand pumps, and plan on "bulk storage" with metered conveyance direct to the tank.

De-enameling is sometimes done with a light preliminary sandblasting. The sand or abrasive must be prevented from contaminating the breathing zone of the workmen. The abrasive used in sandblasting generates a serious silicosis hazard.

All de-enameling operators are strongly advised to procure a copy of

bulletin SD-9 issued by the Manufacturing Chemists Association (608 Woodward Bldg., Washington, D. C.) for 20 cents. These instructions on the use of sodium hydroxide contain complete coverage on the use of this dangerous chemical.

Authorities are prone to give miscellaneous dust an overall classification as "nuisance dust," which they claim causes a higher incidence of respiratory infections. They have even recommended the level of dust particles in the air below which the industry should attempt to remain.

The concensus in our organization is that this nuisance dust causes surface defects. We feel that good surface quality requires much greater dust control than the authorities think necessary for health.

Ceramic coated metals for aircraft power plant applications

By MAJ. R. A. JONES

An important property of metals which are useful for the construction of certain component parts of aircraft power plants is their strength and stability at elevated temperatures. In spite of outstanding developments in the field of heat resistant alloys, present day power plant designers are seriously handicapped in utilizing working temperatures above 1500-1800° F. Furthermore, the so-called "high temperature" alloys which can be used up to these temperature limits generally contain high percentages of scarce and expensive metals.

In order to increase the utility of metals at elevated temperatures and to decrease the requirements for strategic alloying elements, the Air Materiel Command is sponsoring and conducting investigations on the use of ceramic coated metals for certain applications, such as reciprocating engine exhaust systems; jet engine combustion chamber linings, tailpipes, and turbine blades; rocket thrust cylinders, etc. A promising degree of success appears assured in some of these applications.

There are numerous ways in which a satisfactory ceramic coating may produce beneficial results when applied to a metal component part of an aircraft power plant, some of which can be listed as follows:

(a) Retardation of oxidation or corrosion.

(b) Increase of strength and stiffness due to physical presence of coating.

(c) Increase of strength and stiffness due to lowering of the operating temperature by thermal insulation.

(d) Increase of fatigue strength due to reduction of surface stress raisers.

(e) Reduction of the magnitude of temperature gradients and resulting thermal stresses.

(f) Production of surfaces having special finishes, emissivity characteristics, electrical properties, etc.

The degree to which each of these mechanisms is effective depends on the type of coating and the conditions of service, but much fundamental research will be required before they can be completely understood and evaluated.

The use of 1300° F. enamels applied to sheet steel

By B. D. BRUCE

When new developments in porcelain enamel appear on the market, the first question asked by the manufacturers using porcelain enamel as a product finish is, how will this help me? What are its advantages? What are its disadvantages? Can I benefit by the use of the new product in my shop? Manufacturers undoubtedly asked themselves these questions when zircon enamels became available and again when titanium enamels appeared on the market. Now with the advent of porcelain enamels which mature at 1300° F., another new field in enameling appears on the horizon and once again the same questions are being asked.

The major advantage of low temperature enamels is the relative freedom from distorted ware, which is often encountered when porcelain enamel is matured at conventional enameling temperatures. When 1300° F. enamels are used, parts to be enameled may be fabricated from low carbon steel instead of enameling iron and lighter gauge metal may be used with no danger of warpage during the enameling operation. Enameling defects resulting from gas evolution from the steel should also be greatly reduced by the use of 1300° F. maturing temperatures.

Another advantage is the savings in fuel cost for furnace operation. Theoretical fuel savings for a continuous furnace with a 60 ft. hot zone rated at 20,000 lbs. per hour total load is about 20%. Lighter burning tools and also a higher ratio of ware to tooling may be used.

On the disadvantage side of the ledger, slower burning cycles necessitated by slower heat transfer at lower temperatures may be one obstacle. Another problem is adjusting production schedules so that a furnace can be made available for low temperature enamels without upsetting production of other ware which at present must be produced in conventional enamels. The ideal situation would be to have a furnace allocated solely for 1300° F. firing.

Low temperature enamels may be divided into two general classes, one being cover coat enamels applied directly to steel, and the other involving two coat application where a blue ground coat and a cover coat enamel are used. In general, one coat application has been confined largely to low opacity enamels suitable for colors. These enamels are especially suitable for ware, such as space heat-

ers. The chemical durability of one coat low temperature enamels is not as good as that of most conventional cover coat enamels. However, they can be well adapted to use as a product finish where chemical durability is not of major importance.

Where chemical durability is desirable, the two coat method of application in which a blue ground coat is used is preferable. Low temperature zircon opacified enamels which compare favorably with conventional zircon enamels in respect to opacity, gloss, texture and chemical durability are available. Low opacity antimony type enamels with class A acid resistance can be obtained for use as an overspray, or as a full second coat over zircon low temperature cover coat enamel.

The field of low temperature enamels is new, and the knowledge which will be obtained as more of these enamels are used in production will probably be great. The obvious and potential advantage gained through the use of lower temperatures for maturing porcelain enamel warrants the effort which will be necessary in accumulating production data so essential to product improvement. A reduction in maturing temperature while still maintaining the quality of product which has earned for porcelain enamel the reputation of a "lifetime finish," will do much to expand the use of porcelain enamels to fields heretofore dominated exclusively by makers of synthetic finishes.

The design, construction and maintenance of burning tool equipment

By A. Rasmussen

Just as the tree-type fixtures make the box or batch-type furnace more flexible in handling ware, so do special design carriers for the continuous furnace help the enameler to burn many shapes which could not possibly be handled by the conventional coat-hangers. These special carriers are usually designed as hanging-racks which are constructed to support many shapes in horizontal or vertical positions, with points located to keep ware in perfect shape throughout the burning cycle.

In many instances these racks can eliminate the use of wire hooks, and make it possible for one man to load and unload ware from the conveyor. Such special racks have been designed for stove plants where the manufacturers are enameling the entire wrapper as a unit. Special racks have also been designed for handling small panels where a full production schedule requires maximum furnace capacity, for handling washing machine tubs, and for shops specializing in sign work.

Racks should be flexible both from the standpoint of construction and usability. Flexibility of construction allows the alloys to expand and contract without deforming the shape of the rack. Flexibility in usage aids the shop man who does not want to change tooling every time a different type of ware comes from the spray booth.

Another prime requisite in tools and fixtures is the matter of obtaining materials that afford the lightest possible tool to carry the maximum amount of ware, and here the nickel-crome alloys enter the picture.

Nickel-chrome alloys have been found useful due to their resistance to oxidation, their ability to withstand thermal shock, and their strength or load carrying ability at high temperatures.

There are but two or three grades of nickel-chrome alloys which meet the useful requirements in this field. One of these alloys is F-1, or 38-18, which consists of 37 to 41% nickel, 15 to 18% chrome, minor percentages of other elements, and approximately 35% iron.

Another grade is F-5, or 65-20 alloy, which analyzes 64 to 68% nickel, 16 to 19% chrome, minor percentages of other elements, and approximately 10% iron.

The F-1 is a very high strength alloy, while F-5 offers high strength plus the maximum corrosion resistance at elevated temperatures. Although both alloys are successfully used for burning tools, the latter grade is more recommended in light of its excellent corrosion resistance.

Another alloy which is often considered for tooling is an 80% nickel, 20% chrome. This grade is definitely scale-free, but has the disadvantages of having a much lower stress point than F-5; and the cast alloy has a tendency to become brittle to such an extent that after a period of heating and cooling cycles, it becomes impossible to straighten the tools without breaking them.

In striving to obtain light weight tools, it must be remembered that all these alloys have their limitations. An interesting point is in the manner in which the strength of these alloys decrease at elevated temperatures. For example, the 38-18 alloy has an extreme fibre stress of 4500 lbs. PSI at 1400° F., drops to 3100 PSI at 1500° F., and goes down to 2000 PSI at 1600° F.

It will be noted that the extreme fibre stress of the F-5 alloy drops in approximately the same proportion. It is of utmost importance, therefore, that the burning tool designer be given all the necessary information as to the maximum loads to be handled and the temperatures at which they are to operate.

New problems in tooling arise constantly. One of great interest at this time is the design of tools for use in burning new low temperature enamels.

The first problems to arise with these new enamels occurred with the development of the Lustron Home for which low temperature enamels are being used on the architectural panels. Tools were developed which are approximately 40% lighter in weight than the standard tools used for high temperature enamels. This reduction in tool weight was made possible by the greatly increased strength of the nickel-chrome at these lower temperatures. →

Another advantageous feature which these low temperature enamels may produce is the possibility of using the F-1 alloy without the fear of scale.

It may be possible to further reduce tool weight by fabricating them from rolled bars of rounds and flats, but this again offers obstacles as rolled materials do not have the rigidity possessed by cast forms.

It may be suggested at times that enamelers use a still lower grade of alloy consisting of approximately 25% chrome and 12% nickel. There are several definite objections to the use of this grade of alloy for burning tools:

1. 25-12 alloy cannot effectively withstand the thermal shock to which all tools are exposed.

2. In the span of its critical range of 800° F. to 1400° F., carbide precipitation occurs, causing an embrittling condition, and thereby making the alloy highly susceptible to breakage, either in or out of the furnace.

3. Without considering the disasterous effects of furnace jams and shutdowns, the use of this lower grade alloy would mean excessive tooling costs due to continual replacements.

As to the life or service to be expected of burning tools, there are many factors to be considered. Burning tools cannot be expected to render long life if they are overloaded or overfired; nor can they be expected to give full service if they are thrown carelessly about. Bending or breakage of tools can be reduced substantially if they are placed on readily accessible storage racks when removed from the conveyor. However, when they do become bent, they should be straightened cold, as spot heating—such as occurs with use of a torch—can cause cracking. Burning tools should be kept as clean as possible by occasional sandblasting, and sharp points should be maintained to assure minimum contact with the ware. It becomes evident, therefore, that burning tool life and maintenance go hand in hand.

A survey of drying practices in the porcelain enamel industry

By GEORGE N. TUTTLE

While it is universally agreed that proper drying is an important requisite for quality and efficient production, there appears to be relatively little data or literature available for the plant operator. Likewise, a wide divergence of opinion exists among enamelers regarding proper methods of drying, the best type of equipment, and the exact nature of enameling defects arising from improper methods. Only a relatively small amount of information is available on the effect of various gases in dryer atmospheres or the relative efficiency of different types of dryers and fuels. This phase of drying, however, is not within the scope of this study.

Until quite recently it was considered satisfactory to provide drying conditions which would promote the evaporation of water from the enamel with little regard for the control of this evaporation or the varying results which were produced.

Realizing this condition, the PEI Forum Committee decided, as a preliminary step, to secure as much information as possible on drying installations and drying problems encountered throughout the industry. Some three hundred and fifty questionnaires were sent to enamel plant operators throughout the country from which forty questionnaires were returned, representing 61 drying units in the industry. While the response was not as good as expected, it appears that the information obtained represents a fair cross-section of the enameling industry.

Analysis of data obtained in survey

For convenience in reporting data, all plants were divided into four groups: (1) job shops, (2) stove plants, (3) kitchenware plants, and (4) miscellaneous plants. The number of plants reporting in each classification was as follows:

Job shops	12
Stove plants	9
Kitchenware plants	7
Miscellaneous plants	11

One of the outstanding facts revealed by the survey is the lack of any reasonable agreement of drying practices, even in plants processing similar types of ware.

Temperatures vary from 120° F. to 600° F. and drying time from 1½ minutes to 90 minutes. However, a majority of plants report drying temperatures within the 200° to 350° F. range and drying time within the 3 to 6 minute range.

Of the sixty-one reported in the survey, one holloware dryer has a 22% controlled humidity and one other uses steam injection with the per cent humidity unknown.

Forty-one dryers or approximately 70% of the dryers have some form of recirculation varying from 25% to 100% with twelve reporting the per cent of air recirculated as unknown.

As to the type of burners, thirty-five plants use open or convection type burners; fifteen use radiation type burners; five use both radiation and convection type burners; two employ convection type burners in conjunction with recuperator heat; two use recuperator heat only; and one uses direct radiation with infrared lamps.

Summary and conclusions

A summary of the reported drying defects reported and attributed to a drying condition include the following:

Tearing	7
Scumming	3
Dirt	7
Brittle film	7
Ground coat blisters	1
Copperheads	1
Shorelines	2
Rusting	1

Judging from the information reported on the questionnaires, many of the drying units in the survey are producing satisfactory results, at least under their present operating conditions. An observation of the

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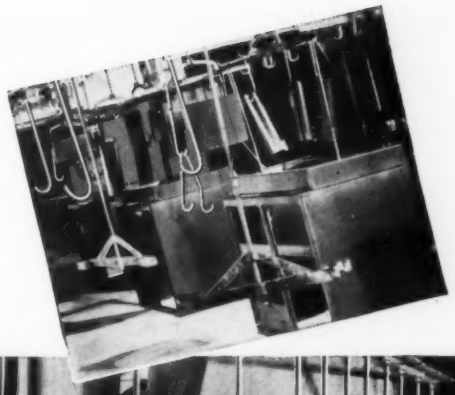

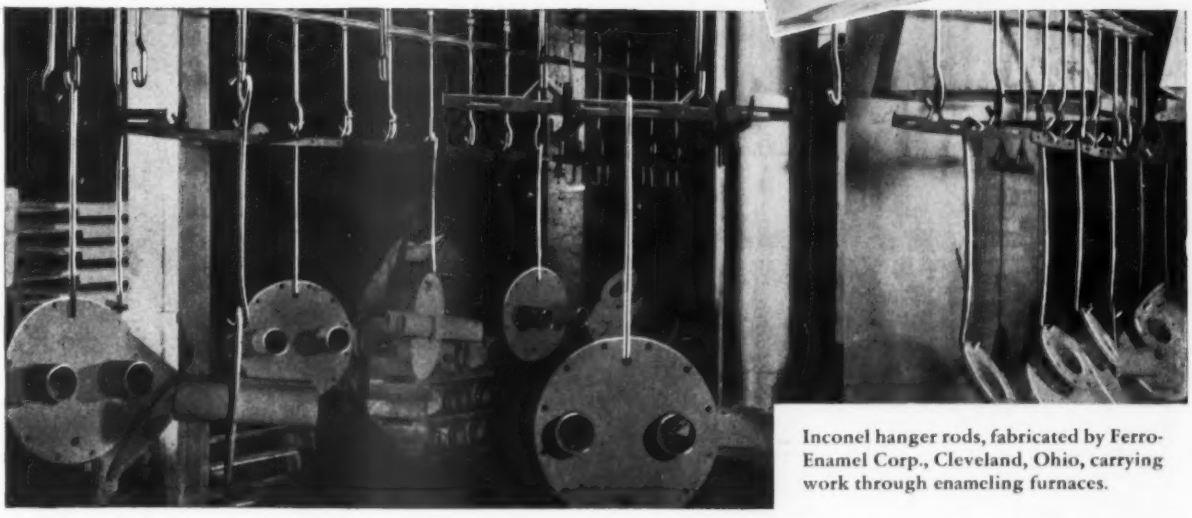

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extremely variable conditions existing throughout the industry raises the question as to just what requirements must be considered in the selection of a dryer system for a particular application.

First of all we must recognize that drying problems vary from one plant to another and may even change from day to day within the same plant. Thus every plant operator is confronted with the job of engineering a drying system with enough flexibility to meet his own particular requirements with regard to type of ware, metal gauges, conveying method, and volume of production.

Present day production requirements demand that the drying rate be speeded up as much as possible without causing drying defects. Too frequently, however, many of the drying defects encountered in practice have resulted from this speedup beyond the capacity of the equipment. Changing production requirements often brings about this condition and it is unfortunate that the ultimate production requirements cannot be forecast at the time the drying system is installed.

In the light of our present limited experience and knowledge of direct radiation drying, any conclusions must be based on convection type drying systems. The design principle is based on transmitting all the required heat to the work with controlled convected air. A sufficiently large volume of air must be circulated through the dryer. This is important in that in maintains a low thermal head with an accompanying low temperature drop which in turn gives better heat distribution throughout and closer temperature control. A maximum operating temperature of 250° F. is recommended.

It is not uncommon to find properly engineered convection systems in the paint industry with a maximum temperature variation at any point within the oven of ± 5° F.

There may be some question as to whether it is necessary to maintain this close a control in the enameling industry. Certainly few, if any, porcelain enamel dryers approach this performance and further studies should be made relative to both heat distribution and the effect of humidity on drying results.

The production application of titanium enamel

By Harold C. Wilson

There is nothing mysterious about the successful application of titania opacified enamels. By following the standard rules of enameling technique, by logical reasoning and by close control of the various operations, any enamel shop should be able to produce quality one cover coat ware.

In order to develop the properties characteristic of this enamel, certain procedures are necessary. First, the selection of a proper ground coat is imperative. Although this is no different than the requirements for antimony or zircon, the degree of perfection of the ground coat for titanium must be much higher. Any defects occurring in the ground coat should be corrected before attempting to apply the cover coat.

In order to develop maximum acid resistance, not more than 4% of clay is advisable. The selection of the proper kind of clay will aid materially in reducing black specks and pimples.

Sodium nitrite and potassium carbonate are good electrolytes for a creamy white enamel. However, when a blue-white enamel is desired, sodium aluminate and potassium chloride are substituted for the nitrite and carbonate.

The attainment of satisfactory film hardness is often quite difficult when using titanium enamels. Gum tragacanth or urea will be of value in increasing bisque strength.

For improved coverage at low application weights, a fine grind 1 to 2 grams of residue using a 50 cc sample on 200 mesh screen, higher specific gravity (about 1.75), and a reduced set, patterned to meet production requirements, should be used. The usual thickness of fired cover coat is .005 inch or 25 to 30 grams per square foot dry weight. Excessive application of titanium enamels may well defeat the purpose for adopting this type of enamel.

Spray booths should be kept scrupulously clean and free from airborne dust and dirt since, with a .005 inch fired thickness of cover coat, it does not take a very large particle of foreign material to extend through the enamel. An inspection before burning is usually advisable.

For maximum acid resistance, reflectance and general quality of finish, a rather hard fire is required. Often, it will be necessary to decide which will be the better piece of ware —the one with a minute black speck on it or the one which has been given an additional coat of enamel because of a black speck, always remembering that with each additional coat of enamel the tendency to spall will be increased.

Several of the defects occurring in titanium enamels are worth noting. An off shade color, for instance, may be due to a variation in application weight, irregular heat distribution in the furnace, improper choice of electrolytes, or changes due to repeated firings. Lumps are quite common and may be due to a buildup of enamel on the tips of the spray guns, dropping on the ware, or may be due to improper gun setting. Reboil is not uncommon and in many instances may be due to excessive or repeated firings. Pitting sometimes occurs due to excessive water vapor in the furnace. Delayed fishscale may be more likely to occur on titanium than on other enamels, but careful pickling and burning methods should prevent this in most cases.

Titanium enamel is not always the most wise choice for a cover coat enamel. In many cases where it is possible to cover with antimony or zircon enamels, titanium enamels are out of the question due to the lower expansion coefficient. This will be found to be especially true on critical radii. If a certain job is causing

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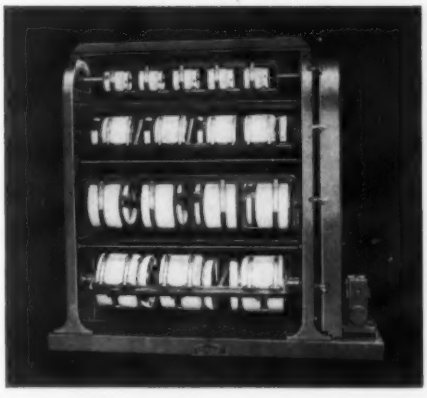

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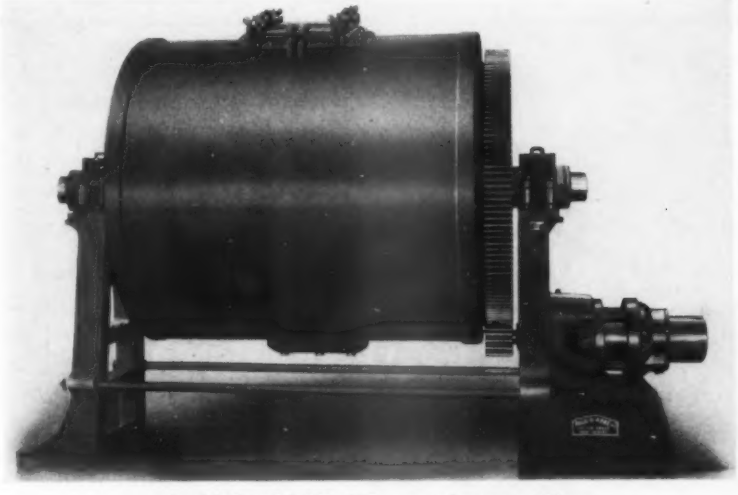
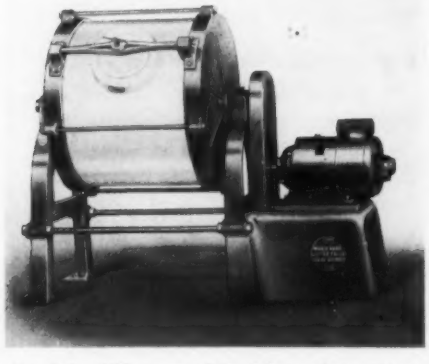


Steel Ball and Pebble Mill — one of many models.



No. 5 Jar Mill — one of the largest sizes — ranges of capacity from ½ pint to 57 gallons are available.

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an unusual amount of trouble, the design of the piece should be checked before experimenting with the enamel formula.

To date, there has been very little accomplished in color development using titanium frit. The very quality that gives titanium enamel its exceptional covering power also makes it a difficult enamel to produce in colors since the recrystallization of the TiO_2 tends to hide the color oxides. Some pastels have been produced but even these must undergo extensive improvements before they can be used in the average shop.

Excerpts from complete papers presented at the Porcelain Enamel Institute Forum are being published as space permits. The list of authors of papers published in this issue follows herewith.

The authors

B. D. Bruce, Chicago Vitreous Enamel Product Co., Cicero, Ill.

Russell Frank, Ferro Enamel Corporation, Cleveland, Ohio.

Maj. R. A. Jones, Air Materiel Command, Wright-Patterson AFB, Dayton, Ohio.

M. E. McHardy, Hussmann Refrigerator Company, St. Louis, Mo.

A. Rasmussen, The Fahralloy Company, Harvey, Illinois.

George N. Tuttle, Benjamin Electric Mfg. Co., Des Plaines, Ill.

Harold C. Wilson, Vitreous Steel Products Co., Nappanee, Ind.

American Gas Association holds thirtieth annual meeting

(Continued from Page 34)

surer, John Van Norden, secretary of American Meter Company, New York, N.Y.

Frank H. Adams, president of Surface Combustion Corporation, Toledo, Ohio, and Nicholas R. Feltes, Bastian-Morley Co., Inc., La Porte, Indiana, were elected to the board of directors.

Highlights of the exhibition

A few of the highlights of the gas exhibition included a completely furnished home installed by Servel on the mammoth stage of the Auditorium. One of the features of the home was a heating system employing dual floors, the space between serving as a plenum chamber for the heating system.

Single point ignition (a method of lighting oven and broiler from surface burner pilot light) was featured by a number of companies. One type of all-gas single ignition was presented by Cribben and Sexton and Hardwick Stove Company on an exclusive basis. Robertshaw-Fulton Controls showed electrically operated pilot ignition.

Two popular spots throughout the exhibition were the elaborate display of A. O. Smith, in a western atmosphere, at which free coffee was served, and the Coke bar at the Rheem Manufacturing Company display.

At the Owens-Corning exhibit, ice cubes packed in Fiberglas were baked in an oven with cookies, and then displayed intact as conventioneers tasted the baked delicacies.

Herman, the "miniature Magic Chef," invited visitors to the large American Stove space.

Youngstown Sheet and Tube Company had one of the most interesting exhibits, consisting of a working model of a complete electric-weld pipe mill.

Porcelain enamel was strongly featured by Caloric Stove Corporation under a heading "America's easiest range to keep clean," demonstrating removable broiler drawers and completely porcelain enameled interior sections.

For removal of long-accumulated, hardened dirt on porcelain enameled light reflectors, a leading maker of fluorescent fixtures reports that an efficient "soapless" soap will do a thorough job with a minimum amount of effort and leave surfaces clean and sparkling.

"Now there's a success story for you. Started in on a shoe string 20 years ago and worked himself all the way up to neckties!"

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CHICAGO

The Washington round-up

By Wilfrid Redmond

SECRETARY of Commerce Charles Sawyer recently warned that industrial users of steel can expect few, if any, new programs to be developed for the allocation of critically needed steel under Public Law 395.

A few days prior to the announcement, the request of manufacturers of pressed steel plumbing fixtures, for 5,300 tons of steel monthly, had been turned down by the Steel Products IAC. Of nine programs submitted to the industry committee, which is composed of sales executives of the steel companies, four were rejected and four postponed.

The Secretary said that the voluntary agreements program is grinding to a halt because of the fact that agreements made under the law must expire on March 1, 1949. Since steel mills generally require an advance notice of 60 days to enable them to schedule production—a period known as "lead time"—and because each program can only be approved after numerous meetings with industry representatives, three to four months would be required to set up a program. This would allow about one month for the delivery of steel under the program.

At this time, the Department of Commerce has not received a ruling from the Department of Justice on a provision in Public Law 395 which may permit the continuation of programs for six months beyond the cut-off date (March 1, 1949) if they have been approved prior to that time. However, the Justice Department has indicated that the law allows programs that are in operation on March 1 to continue on a unilateral basis for a run-off period of up to six months.

It is reported that Senator Wherry will introduce an amendment to the Act as soon as Congress convenes which will extend the authority of the Department of Commerce under the present law until such time as the new Congress, assuming it is a Republican Congress, has time to write effective legislation.

No easing in steel supply foreseen

It is now obvious that any long-term operation of the voluntary allocations program for steel would run into serious difficulty. Even now some industries which do not have a preferential status are feeling the pinch. It is also evident that steel will be tighter next year than it has been. Congress therefore has to consider whether or not it will be advisable to place all steel under allocation or return the problem to industry.

If an allocations program, voluntary or otherwise, is not enacted, the steel industry may expect continuous investigation, such as has been conducted by the Senate Small Business Committee, and the Macy Committee of the House.

Secretary Sawyer says he addressed a letter to Congressional leaders last June 4, calling attention to the fact that operation of the allocations program for steel would be seriously impaired unless the time for termination was extended. Congress did not extend the authority.

Allocations program considered for copper, lead and zinc

During the past month, the Department of Commerce has announced an allocations program would be considered for the stockpiling of copper, lead, and zinc. Industry committees have been appointed in each case to talk over this proposal with the Munitions Board. It may be that the producers of these metals will reject such a program even though the Munitions Board has a "club in the closet" in a provision of the draft law which gives the President authority to direct a plant to fill military orders or risk seizure by the Government. Any allocations program in the area of non-ferrous metals will, of course, have immediate effect on the already tight supply situation.

The Munitions Board recently announced an offer to purchase for the period ending June 30, 1949, 30,000 tons of copper, 15,000 tons of lead, and 15,000 tons of zinc. Spread over a period of nine months this would not be a large withdrawal from civilian supply, but with production not meeting domestic demand, it would be felt by consumers.

The Federal Trade Commission recently completed its case against the steel industry, which is charged by FTC with a conspiracy to fix prices through the operation of the basing point system. The steel producers (101 of them are charged in the complaint) will present their side of the case next month. This may run into years. The Pittsburgh plus case, which FTC started in the 20's, was terminated just recently by a consent decree.

The Capehart Trade Policy Committee of the Senate will begin hearings in November on the basing point system of pricing steel and other products as a basis for writing legislation to outlaw this method of marketing.

Activity in enameled products

The Department of Commerce recently issued a report on activity in selected enameled products for June, the last report to be issued, it was announced.

Activity in enameled products (metal base only) totaled $4.6 million during June. This was 8 per cent lower than in May when activity amounted to $5.0 million. The June total included $3.7 million of finished enameled products and $917 thousand of receipts for enameling done on a jobbing basis.

Record shipments of steel have enabled manufacturers of varied products to make gains against their backlogs, and in the case of refrigerators and washing machines to exceed the estimates of accumulated demand, the American Iron and Steel Institute said recently.

In the two and a half years since the war, manufacturers have produced 7.5 million electric refrigerators, 8 million washing machines, and more than 10 million stoves and ranges. The Office of Civilian Requirements in 1945 estimated the de-

terred demand for household washing machines at more than 5,800,000 units; actual production since the war ended has exceeded that figure by 2,500,000 units. The accumulated mechanical refrigerator demand was estimated by the Office of Civilian Requirements in 1945 at 5,852,000; production of electric units in two and a half years exceeded this figure by more than 1,500,000, the Institute reported.

All fabricators of metal base products have become used to living with short supplies both of the metals and metal base chemicals, and it does not appear these situations will undergo much change for the better within the next few months. Copper, lead, zinc, and tin plate are being shipped to the Marshall plan nations to take the place of finished products and to provide employment which will enable Europe the more quickly to get on its feet.

Export licenses denied for lead

Italy, Belgium, and Holland recently denied export licenses for the shipment of lead, an action which has never been formally explained by ECA. However, officials said that this action was taken because ECA threatened to cut off relief shipments if these countries continued exportation of this metal.

A mission was sent by ECA to Europe in August to negotiate the payment in strategic materials for some of our grants and loans to the relief nations. ECA has not indicated whether or not this mission was successful.

With the non-ferrous metals in shorter supply than they were when Congress met last January, the supporters of subsidy legislation to stimulate production of these metals from marginal mines will renew, with greater hope of success, their efforts to make the mining of these properties a profitable operation. This program will be pushed in Congress with greater support, particularly if the present producers of these metals are unable to supply the requirements of our military stockpile. The subsidy program was defeated in the waning hours of the second regular session of the 80th Congress, largely through the opposition of Senator Kem, of Missouri.

If domestic production continues to lag behind demand in the non-ferrous metals, we will have to depend upon increased imports and at higher prices.

Porcelain enamel mural dedicated at Kansas Free Fair

(Continued from Page 35)

slight color variations which are not always visible on close inspection.

The mural was erected in June by Ray Anderson, but was covered with a canvas until its unveiling on September 11. Dedication ceremonies were conducted by Col. Cornelius P. Van Ness, USMC. His guest was Rene Gagnon, one of the three surviving Marines who participated in the actual flag raising on Iwo Jima.

In addition to the pylon, a new Home Appliance display building on the fair grounds was also constructed of architectural porcelain enamel, utilizing some 10,000 square feet of the material.

Book on store modernization published

Five basic aspects of store modernization are included in an illustrated book of the 1948 Store Modernization Show's Clinics, according to John W. H. Evans, managing director of the Show.

Including five chapters, "Store Layout and Traffic," "Store Lighting and Color," "Displays and Fixturing," "Store Fronts," and "Planning and Budgeting for Modernization," the book reveals details of the 1948 trends by leading authorities in the field.

Herber L. Tigges, second vice president of the American Society of Tool Engineers, has accepted an assignment as advisor and consultant to the National Security Resources Board in connection with work of the manufacturing division, it has been reported.

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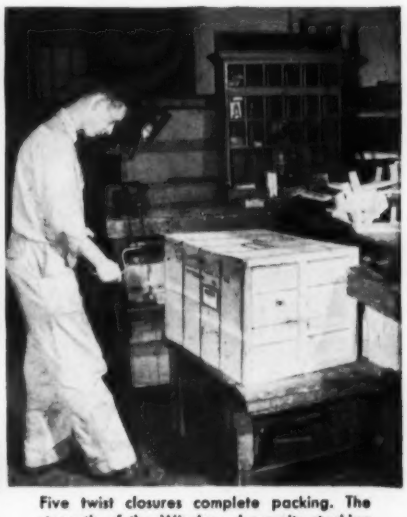

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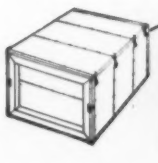

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NEWS

Central enamelers meeting

The Frigidaire Division, General Motors Corporation, Dayton, Ohio, will be host to the Central District Enamelers Club on Friday evening, November 12, at its Moraine City plant. Following a dinner at 6 p.m., a tour of the plant will be made. All reservations must be by November 8, according to M. Bozsin, secretary-treasurer of the Club.

Appointments at N. Carolina State

The Ceramic Engineering Department of North Carolina State College has announced the appointment of Dr. Milton A. Tuttle as associate professor and C. Rogers Westlake as instructor of ceramic engineering. Dr. W. W. Kriegel, head of the department, also announced the promotion of Charles V. Rue from instructor to assistant professor.

Perfection Stove promotes Gredys

Daniel N. Gredys has been promoted to assistant general superintendent of Perfection Stove Company's Platt Avenue plant in Cleveland, Ohio, according to H. A. Sage, plant manager.

Following his graduation from Case Institute of Technology in 1935, Gredys joined Perfection as a chemical engineer. Four years later he was made assistant superintendent of the enameling shop at the Ivanhoe Road plant.

During the war he acted as foreman of the aircraft departments at Perfection and as production engineer at the Ivanhoe plant. In 1946 he was made assistant general superintendent of the Ivanhoe plant.

W. B. Lawson dies

William B. Lawson, president and treasurer of Ferro Chemical Corporation and a director of Ferro Enamel Corporation, Cleveland, died September 29 as a result of a fall from a horse while fox hunting.

Born in Hurley, N. Y., Lawson spent the first 25 years of his business life with International Nickel Co. Before founding W. B. Lawson, Inc., in 1940, he had been with Harshaw Chemical Co. for 10 years. He became affiliated with the Ferro organization when his own firm was merged with Ferro Chemical.

Howlett to head Container Lab.

The American Management Association has announced that Henry J. Howlett, secretary of AMA for 13 years, has resigned to become president of Container Laboratories, Inc., packaging and packing engineering consultants. In his new position, Howlett succeeds the late E. A. Throckmorton, Jr.

He will direct the nation's largest organization serving packaging suppliers and users as consultants on package methods, organization, development, testing, design, engineering and research. The firm was founded in 1923 by A. W. Luhrs, present chairman of the board, and is the originator of many package testing devices now used throughout industry.

ICHAM 16th annual meeting in Cincinnati, Dec. 6-8

The Institute of Cooking and Heating Appliance Manufacturers has announced that its 16th Annual Convention and Exhibit will be held at Netherland Plaza Hotel, Cincinnati, December 6, 7 and 8.

Archie Johnston to Nashville Corp.

It has been reported that Archie S. Johnston, formerly a foreman in the enameling department of Ingersoll Steel Division of Borg-Warner Corporation, Chicago, is now with Nashville Corporation, Nashville, Tenn. He will do control work in the enameling plant, it was stated.

Armco official dies

Newman Ebersole, director of purchases for Armco Steel Corporation, died recently in Cincinnati, Ohio.

A graduate of Cornell in 1910, Ebersole first became associated with Armco in 1911, as a weighmaster in the bar mill. Later he was promoted to assistant to purchasing agent, and in 1937 was named general purchasing agent. He was advanced to director of purchases in 1944.

$2,000,000 expansion program begun by Clyde Porcelain

A $2,000,000 expansion program which will add 230,000 square feet to present facilities at Clyde Porcelain Steel Corporation, Clyde, Ohio,

was announced recently by C. C. Wells, president, who stated that ground for the new building, to be known as Plant 3, was broken late in September.

The building is being erected on a 20-acre tract adjacent to Plant 1, and will increase present manufacturing facilities by approximately 70 per cent. It will provide 115,500 square feet for production purposes, 50,000 for raw material storage, and 64,000 for finished product storage.

It was stated that the expansion will enable the Clyde concern to manufacture additional products for Bendix Home Appliances, including dryers and ironers. Construction schedules call for completion of enough of the building for operation of the first production line before the end of this year.

Important effects of the program, stated Wells, will be the stabilization of employment, an increase in personnel from 1350 to at least 1900, and a substantial boost in the payroll which is expected to exceed $5,500,000 annually.

Baking ice cubes at Atlantic City

This happy group witnesses a demonstration of the insulating qualities of a popular range insulation material in the Owens-Corning booth at the gas industry exhibit at Atlantic City. Ice cubes packed in Fiberglas insulation are removed from the oven simultaneously with completely baked cookies as an effective demonstration.

Left to right in the picture are: John J. Winn, vice president and general manager of Honolulu Gas Co., Ltd.; Jacqueline Jenkins, Fiberglas demonstrator; Helen Kendall and Lee Chapman, of Good Housekeeping Magazine; W. W. Kuenn, Owens-Corning appliance sales manager; and, kneeling, L. L. Frost, Jr., sales promotion, Owens-Corning.

Central enamelers hold annual outing

The Central District Enamelers Club's annual fall outing was held Saturday, September 11, at the Alliance Country Club, Alliance, Ohio. A total of 109 persons attended the very successful outing which was opened with a golf tournament in the afternoon.

Dinner was served at 7 o'clock in the evening, after which the prizes for golfing and door-prizes were awarded. The formal part of the meeting ended about 9 o'clock, and the remainder of the evening was devoted to card playing in the social hall. Prizes consisted of golf supplies, a golf bag, and many other items.

"Bart" Fennessy to Metalloy

Barton E. Fennessy, identified for over 20 years with Harshaw Chemical Company, and O. Hommel Company, on sales and service to the ceramic industry, is now associated with Metalloy Corporation, Minneapolis, Minn.

In his new connection, Fennessy will specialize on the introduction of Metalloy's new lithium compounds to both the porcelain enamel and pottery fields.

Youngstown is host to 11,000 visitors at open house

Youngstown district plants of the Youngstown Sheet and Tube Company were hosts to nearly 11,000 visitors for open house on October 5. Among the visitors were several thousand high school students who were brought to the plants in special busses.

Instantaneous melting of frit discussed at Trenton ACS meeting

At the first fall meeting of the Trenton Section of the American Ceramic Society, September 24, at Jack Fowler's restaurant, a demonstration of induction and dielectric heating equipment was presented by the Scientific Electric Company.

John Sedlacsik, president of the company, and Mr. McGonnigle, chief

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1350° enamels!

The critical shortage of good enameling stock, due in a large measure to the great expansion of the Porcelain Enameling Industry since the war, has stimulated research on lower temperature enamels. Major quest, of course, has been for satisfactory 1350° enamels, necessary if ordinary cold and hot rolled steel is to be used successfully. Wide interest in the subject has prompted Ferro to depart from its policy of not publicizing new products until they have been entirely perfected and used under production conditions. We will attempt in this space to make a full report to our friends in the industry.

Ferro's researchers and engineers have had *years* of experience with 1350° enamels. Even before the war, and during the period when they were pioneering radical improvements in Zircon Covercoats and One-fire Colored Groundcoats, Ferro technicians were experimenting with these low temperature enamels, exploring hundreds of formulas and diverse firing techniques.

In the past two years low temperature enamels have had top priority in Ferro research. Considerable progress has been made—not on just one or two frits, nor on one or two types of frits, but on a *complete line* of frits. Here is their status today:

1350° Groundcoats—Two frit combinations "look good" in laboratory tests, are now being tried out in a few plants.

1350° White Non-AR Covercoat—This frit is *ready*, proved in numerous field tests; compares favorably with our Zircon white #1948 in color and opacity.

1350° White AR Covercoat—Laboratory reports very promising; has Class "A" acid resistance and only slightly lower opacity than our #1506 and #1511.

1350° Clear AR (for dark colors)—Still in laboratory; not yet ready for field tests.

1350° Non-AR (for dark colors over groundcoat)—Frits similar to our #1082 and #1084 show encouraging results in the laboratory, but more tests still needed before releasing to trade.

1350° Direct-to-steel (for dark colors)—Laboratory reports good progress on frits comparable to our #2066 and #2069; expects to have product ready for field tests soon.

1350° White Direct-to-steel (for pastel colors)—A brand-new and revolutionary frit appears to have been perfected; is now undergoing tests in several customers' plants.

All production-proving of these low temperature enamels has been done, to date, in plants close to Cleveland so that Ferro technicians could supervise and closely follow the tests. This practice we intend to continue on frits still in the development stage. On the other hand, samples of the more advanced frits are now available for trials generally.

While it is not our policy to convert your plant into an experimental laboratory, your Ferro representative will be happy to arrange for samples and to discuss with you trial runs in your plant. And as further progress is made, he will keep you posted. Yes, in 1350° enamels, too, Ferro is on top of its job—helping to build a bigger and stronger Porcelain Enameling Industry.

ENAMEL CORPORATION, Cleveland 5, Ohio

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engineer, described some applications of the equipment in industry and demonstrated potential ceramic applications. These consisted of the instantaneous melting of frit, glazing of wall tile in a fraction of a minute, and the application of ground and cover coats to enameling iron.

The Section's next meeting will be held November 19, according to J. T. Smith, publicity chairman.

Chicago enamelers discuss new silo

Fifty-six members of the Chicago District Enamelers Club attended a luncheon meeting, Saturday, September 25, at the La Salle Hotel.

Following the luncheon, Wesley O. Martin, A. O. Smith Corporation, Milwaukee, discussed a new farm product, the "Harvestore" (silo), which was developed and field tested by A. O. Smith, and will be placed on the market next year.

This mechanical crop storage unit embodies several remarkable features, stated Martin. The standard structure is 14 feet in diameter, 40 feet high, and has a capacity of about 140 tons of corn silage. The walls are thin sheets of steel to which glass has been fused both inside and out. The unit is airtight and is unloaded from the bottom by a mechanical device that delivers hundreds of pounds of silage per minute.

The first Harvestore was put into field service in the fall of 1945. *(See "Porcelain Enamel Goes to the Farm," finish, Feb., 1946.)* The newest unit was displayed during the past summer at the Wisconsin Centennial State Fair where an estimated 5000 persons a day saw the silo.

Before the close of the afternoon session, the enamelers were given a demonstration on "New Magic in Porcelain Enameling" by Woodrow "Woody" Carpenter, a sleight-of-hand expert from Ingram-Richardson Manufacturing Co.

The next meeting of the Chicago enamelers will be held December 4.

NESA convention and exhibit in Chicago, Jan. 31, Feb. 1-2

The 3rd Annual Convention and Equipment Exhibit sponsored by the National Electric Sign Association will be held at the Sherman Hotel, Chicago, January 31, February 1 and 2.

Subjects to be discussed at the business sessions by outstanding men in the sign industry will include labor relations, shop methods, inventory and cost procedure, handling lease contracts, maintenance, selling and sales promotion.

Toussaint advanced by Conlon-Moore

Appointment of Monroe A. Toussaint as Conlon Division assistant to the president was announced by Bernard J. Hank, president of Conlon-Moore Corporation, Cicero, Ill.

Toussaint has been active for 20 years in the household washer and ironer manufacturing field, most re-

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Yes, your ranges sell faster when they are equipped with TK Monotubes—the cooking unit that your distributors and dealers recognize as having clear-cut, easy-to-demonstrate advantages which are quickly seen and appreciated by Mrs. Range Buyer.

TK Monotubes have a unique swivel action that allows the heating coil to be easily raised to a standing position—out of the way—for convenient cleaning of the pan assembly, even when the unit is hot. The coils are *flat*—assuring a bigger utensil contact area, faster cooking and better heating efficiency—and they *remain flat* for the life of the unit.

TK Monotubes are made with the best of materials and workmanship and can be easily adapted to your ranges. And, *Monotube features are easier to sell than to sell against!*

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cently as general manager of American Ironing Machine Division of Barlow & Seelig Mfg. Co. He is chairman of the sales and advertising committee of the American Washer and Ironer Manufacturers' Association.

Westinghouse to sponsor materials handling conference, November 8-9

The second materials handling conference sponsored by Westinghouse Electric Corporation will be held in Buffalo, N. Y., November 8-9. The first day's session will be at Hotel Statler, and the second day's session in the auditorium of the Buffalo plant of Westinghouse, it was stated.

Plan additional laboratories at Battelle Institute

To house additional laboratories required for its ever expanding research, Battelle Memorial Institute, Columbus, Ohio, will begin construction of a new half million dollar laboratory building late this year. According to Clyde Williams, Battelle director, the structure is scheduled for completion in 1949.

Williams stated that the three-story structure will contain space for 103 unit laboratories, plus large open areas for pilot-plant operations. It will contain approximately 80,000 square feet of space.

Harbison-Walker appointment

Harbison-Walker Refractories Company has announced the appointment of A. R. Maune as superintendent of the company's plant at Fulton, Mo. Maune succeeds H. L. Harrod who was named district superintendent, said the report.

International gas conference in London in June, 1949

The 4th International Gas Conference, sponsored by the International Gas Union, will be held in London, June 15-17, 1949. The Union is comprised of national gas associations throughout the world, with headquarters at London and Zurich.

It was stated that participants at the Conference are also invited to attend the 86th Annual Meeting of The Institution of Gas Engineers in London on June 13-14.

Tom Smith retires as president of Pressed Metal Institute

The retirement of Tom J. Smith, Jr., as president of the Pressed Metal Institute has been announced by Woodward G. Jeschke, chairman of the executive committee of the PMI board of trustees.

Jeschke said that Smith had considered retirement previous to his reelection as president last April, but decided to remain in office in the interests of the stamping manufacturers, especially the smaller ones who have been harassed by lack of material.

Pending action of the board, PMI activities will be directed by Walter

A. Gorrell, vice president, stated Jeschke.

Fowler Manufacturing Company, Portland, Oregon, has announced that it will use Nash-Kelvinator distribution in Oregon and Washington. The Fowler company noted that it now has 25 models of electric water heaters on the market.

Sims named general foreman of Estate enamel plant

The appointment of Charles Sims as general foreman of the enamel plant of Estate Heatrola Division of Noma Electric Corp. was announced by A. M. Krieger, works manager. Sims, assistant foreman since 1937, succeeded G. J. Holzberger who resigned.

Carnegie-Illinois advancements

Gary works of Carnegie-Illinois Steel Corporation has announced the promotion of J. Norman Quinlan to assistant to general superintendent of the plant, Quinlan, who has been associated with the plant since 1907, will be succeeded by Charles J. Hunter as division superintendent of the west mills.

McMurdie to head section at Bureau of Standards

H. F. McMurdie, an authority in the field of microstructure, has been

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appointed chief of the constitution and microstructure section of the Mineral Products Division of the National Bureau of Standards.

McMurdie has been a member of the Bureau staff since 1928. For the past 13 years he has been actively engaged in phase-equilibrium studies of systems involving the refractory oxides and in studies of the constitution and microstructure of nonmetallic mineral products. He is a member of the American Ceramic Society.

Third annual materials handling show in Philadelphia, Jan. 10-14

The 3rd National Materials Handling Show will be held at Convention Hall, Philadelphia, January 10-14, according to an announcement by Clapp and Poliak, Inc., the exposition management.

Advance registration cards may be obtained from Clapp and Poliak, Inc., 350 Fifth Avenue, New York 1, N. Y. Hotel reservations may be obtained through the Secretary, Housing Bureau, Materials Handling Show, 17th and Sansone Sts., Philadelphia 3, Pa., it was stated.

Gas industry gains in second quarter of 1948

Total revenues from sales of gas utilities amounted to about $358,000,000 in the second quarter of 1948, a gain of 7.5 per cent over the comparable quarter last year, the American Gas Association reported. Revenues from industrial sales represented the highest percentage gain, rising 10.6 per cent, while residential and commercial revenues increased 6.3 per cent and 7.2 per cent over the like period in 1947.

Atomic washers in offing?

Practical uses of atomic power will not be developed for at least ten years, according to David Lilienthal, chairman, Atomic Energy Commission. Nevertheless, in a recent national broadcast from Boston, Lilienthal used the household washer as his lone example of the new energy application.

Ultimately, "a substantial part of our energy supply—say 10 to 20 per cent—will come from atomic energy," Lilienthal predicted.

Arthur E. Kimball, Chicago zone sales manager for related products of Minnesota Mining & Mfg. Co., St. Paul, has been promoted to manager of development and sales for heavy grinding products in the company's abrasives division, according to an announcement by the firm's home offices.

Improvement of product quality studied at G-E course

Many ways in which electric heat can be extended throughout industry to cut production costs and improve product quality were studied by 175 electric utility engineers who attended a General Electric industrial heat-

ing course at Sacandaga, N. Y., late in September.

H. M. Webber, of the firm's industrial heating division, told the group that electric furnace brazing has made it possible to simplify product design, save material, and lower production costs. Electric furnace brazing is used in the manufacture of parts for refrigerators, airplanes, automobiles and tractors, according to Webber.

George Green to Cribben & Sexton

It has been reported that George W. Green, formerly superintendent of enameling at General Porcelain Enameling Co., Chicago, has been appointed enameling superintendent of Cribben & Sexton Co., Chicago. Green has been active in the enameling industry for 38 years.

John Trenke has been named enamel superintendent for Machine Craft Mfg. Co., El Monte, Calif., it has been reported.

Hommel appoints coordinator of research & manufacturing

John F. Matejezyk has been appointed coordinator of research and manufacturing for the O. Hommel Company. He recently was associated with Pittsburgh Coke & Chemical Co., where, as head chemist in the activated carbon division supervising research and process control, he was engaged in organic analytical research related to the development and production of new compounds.

Hotpoint begins operation in new electric range plant

Hotpoint's new electric range plant, Chicago, occupying one million square feet of manufacturing space, was opened for formal operations with an open house in September.

James J. Nance, president, stated that the new plant has a rated capacity of 600,000 ranges a year. He addressed a group of Chicago press men, industrial and civic leaders who attended dedication ceremonies at the open house.

New homefurnishings market dates for three years announced

New homefurnishings market dates in Chicago for the next three years were recently announced as follows:

1949—January 3 to 15, July 5 to 16; 1950—January 9 to 20, June 19 to 29; 1951—January 8 to 19, June 18 to 28.

The decision on the new market dates was announced by the board of governors of the American Furniture Mart and the management of The Merchandise Mart, following conferences with the joint market dates committee of six home furnishings trade associations and the Greater Chicago Hotel Association.

TAM joins National Lead family

National Lead Company is taking over the business of Titanium Alloy Manufacturing Co., it has been announced. To be taken over are the

head offices of TAM, in New York City, and its plant at Niagara Falls, N. Y., which will be operated as a division of National Lead Co.

The Niagara Falls plant produces compounds of zirconium for use in the ceramics industry and alloys of titanium for use in the ferrous and non-ferrous metal industries.

Twenty-six new members join PEI

Twenty-six new member companies have been added to the Porcelain Enamel Institute roster since the beginning of its 1948 membership campaign, according to the PEI Development Committee chairman, John Tuthill, The Youngstown Sheet & Tube Co., and co-chairman, Dana Chase, publisher of *finish*.

At the PEI 1946 annual meeting, a revision of its by-laws permitted the acceptance of a new group of manufacturers, designated as "Associate" members, who produce porcelain enamel for their own product use. This was in line with a general policy of expanded Institute development for greater service to the porcelain enameling industry as a whole.

Notable in the new enrollment has been the application of a number of manufacturers of formed metal plumbingware. After the Institute's 17th annual meeting in Chicago, October 29, these new members will become active as the Formed Metal Plumbingware Division of the PEI.

The following are the companies who joined this year:

AllianceWare, Inc., Alliance, Ohio; American Central Div., Avco Mfg. Corp., Connersville, Ind.; Aktiebolaget Gustavsbergs Fabriker, Gustavesbergs, Sweden; Architectural Porcelain Constructors, Oakland, Calif.; Briggs Mfg. Co., Detroit; Caloric Stove Corp., Topton, Pa.

Davidson Enamel Products, Inc., Lima, Ohio; Dwyer Products Corp., Michigan City, Ind.; General Porcelain Enameling & Mfg. Co., Chicago; Hope Body Works Div., Charles Hope, Ltd., Brisbane, Australia; Illinois Water Treatment Co., Rockford, Ill.; Ingersoll Steel Div., Borg-Warner Corp., Chicago.

Mullins Mfg. Corp., Warren, Ohio; Murray Corp., Scranton, Pa.; Newark Stove Co., Newark, Ohio; Norris Stamping & Mfg. Co., Los Angeles; Porcelain Enamel Specialties Co., Baltimore; Porcelain Engineering Co., Chicago; Geo. D. Roper Corp.; Rockford, Ill.

Smoot-Holman Co., Inglewood, Calif.; Southwest Porcelain Steels Corp., Sand Springs, Okla.; Strong Mfg. Co., Sebring, Ohio; U.S. Phosphoric Prod. Div., Tennessee Corp., Tampa, Fla.; U. S. Porcelain Enamel Co., Los Angeles; and Jury Holloware, Brierly Hill, England.

N. Carolina college organizes ceramic research section

The School of Engineering at North Carolina State College, Raleigh, recently organized a ceramic research section under the Department of Engineering Research. It was stated that work in the field of enamels and ceramic coatings is anticipated.

Bendix appoints director of engineering research

Raymond L. Coultrip has been appointed director of engineering re-

search for Bendix Home Appliances, Inc., according to W. F. Oliver, vice president and director of engineering.

Coultrip joined Bendix after serving as project engineer in charge of range development for The Maytag Co.

Packaging, shipping problems headline Eastern enamelers program

R. F. Bisbee, manager of quality control for Westinghouse Electric Appliance Division, and general chairman of the recently organized Packaging and Shipping Committee of the Porcelain Enamel Institute, will be the feature speaker at the first fall meeting of the Eastern Enamelers Club, Saturday, November 13, at Sylvania Hotel, Philadelphia.

In announcing the topic for the meeting, Nathan Klein, club president, stated "The porcelain enameling industry is believed to be the first industry on record to make a concerted effort to reduce freight losses through a packaging and shipping standardization program. The tremendous losses being experienced by product manufacturers today, due to the lack of standardization on packaging and shipping procedure, makes Mr. Bisbee's talk one of current importance to every producer."

A simultaneous announcement with the November meeting date was released by Howard N. Williams, club secretary, to the effect that the Eastern Enamelers Club Executive Board has approved the following dates for their 1948-1949 meetings:

First meeting—November 13, 1948 —Philadelphia, Penna.

Second meeting — February 19, 1949 — Baltimore, Maryland.

Third meeting — May 14, 1949 — Philadelphia, Pennsylvania.

Annual Outing meeting — September, 1949 — No location approved.

PMI executive suggests plan for attacking "gray market"

Commenting upon the Macy Congressional Committee Report (published October 14) on the extent of the gray market in steel in the United States, Walter A. Gorrell, vice president of Pressed Metal Institute, said that members of the PMI — who are manufacturers of metal stampings — had long been acutely aware of the existing gray-market conditions.

"The fantastic profits taken by some middlemen through the present practices of gray-marketeers," Gorrell said, "affect the manufacture and sale of many articles presently demanded by home builders and home owners in the United States. The gray markets have long been recognized by PMI as a growing menace to the manufacture of stampings, which is one of this country's greatest mass-production industries. . . .

"This industry supplies a major proportion of metal parts to manufacturers of stoves, refrigerators, bathtubs, washing machines, automobiles, farm machinery, television sets, and scores of other consumer goods in high demand. . . .

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The introduction of lithium compounds in titania enamels

(Continued from Page 23)

Another similar series of tests was carried out on a titanium enamel, called No. 3 (see Table No. I), which is composed of a few ingredients only, and also has a very low calculated coefficient of expansion, namely 236 x 10^{-7}. In this case results were obtained as follows:

	Total thickness in mils	Per cent reflectance (green filter only)	Acid resistance	
			Class	Solubility test
Frit No. 3				
(a) Without lithium	9.0	72.5	A	—
(b) with 3.5% lithium silicate added	8.9	83	AA	.0009

In this special case, since the enamel was considered extremely hard, an addition of 3.5% of lithium silicate was tried for experimental reasons only.

A very good proof of the influence of the lithia addition to this particular titania enamel is evident from the spectrophometric curves in Chart 4 which illustrate these enamels burned at 1560° for 2.1 minutes. The non-lithium bearing frit shows a reflectance of 70%, while the same enamel (No. 3 L) with 3.5% lithium silicate added to the smelter, burned under the same conditions, results in a reflectance of 83% with an improved color curve.

When using a composition of normal hardness, Frit No. 1 (Table I.), with a calculated coefficient of expansion of 277 x 10^{-7}, it was found, however, that higher additions of lithium silicate are of little value. Slight gains in reflectance would apparently not justify the costs of higher lithium additions:

Lithium silicate added to Frit No. 1	Total thickness in mils	Per cent reflectance (green filter)
1.5%	10.6	81.5
3 %	10.4	82
6 %	10.8	85

(Samples burned at 1530° for 2 minutes.)

Another type of tests were run in order to determine whether the amount of titanium dioxide could be reduced when lithia was used as fluxing agent. The results are shown in Table IV.

The opacity increased with the higher amounts of titania; the color stability increased with higher lithia contents. Results were improved with lower burning time.

The basic composition used for this series of tests is on the creamy side. From these results it seems possible that with introduction of the optimum amount of lithia good reflectance should be obtained with less titania present, while better color stability and lower firing conditions can be expected.

Chart 4 illustrates also the combination of 15% TiO_2 and 0.75% lithium silicate, burned at 1550°—1¾ minutes.

IV Summary of results

From the great variety of tests run it is apparent that various lithium compounds can be introduced in titania enamels. Similar to the results obtained in ground coat and single coat enamels, small percentage additions of lithia in the precompounded form act as very powerful fluxes. These additions can be made either to the raw batch formulae in the smelter or to the mill. When using commercial frits the action of lithia is advantageous as a mill addition.

Some of the compounds can be used without any necessary alteration of mill formula or of regular practice whereas others require some precautionary measures. The fluxing action seems to be slightly different from one compound to another. So far it has been found that lithium silicate is an ideal smelter addition, while as mill additions preference is given to lithium titanate, lithium zirconate, and lithium zirconium silicate. The additions will vary from 0.5% to 1.5% depending upon shop conditions and upon the frit used.

In practically all cases it was possible to (a) reduce firing time and temperature, and (b) improve the color stability and reflectance. When introducing the lithium compound in the smelter, the smelting time and temperature was also reduced.

In view of the low percentage additions of the thin coating, and of the increased production, the costs are not prohibitive. It is, furthermore, of interest that with the help of lithia an economical saving on titanium oxide seems possible.

It can be assumed that any commercial or given frit will show improvements as noted, when lithium compounds are added to the mill. When used as a smelter addition, lithia should not replace other alkalis but only be considered as a fluxing agent introduced in small percentages without otherwise disturbing the equilibria of the composition.

This paper can only be considered as a report on preliminary work carried out on a very complex subject. The results are promising and should promote further and more detailed investigations.

1. Paul A. Huppert, "Lithium Compounds in Porcelain Enamel Compositions," *finish* 4, No. 6 and 7, 1947.
2. A. L. Friedberg, F. A. Petersen, and A. I. Andrews, "Effect of Composition on Properties of Titanium Enamels," Journal American Ceramic Society, 30, 9, p. 261, 1947.
3. L. Stuckert, "Acid Resisting Enamel," U. S. Patent 2,209,585, 1940.
4. Otto Schott, "Lithium Glass," Sprechsaal 13(1880), No. 14,15.
5. A. Dietzel and R. Boncke, "Die Truebung von Emails durch Titandioxyd," Sprechsaal 75, 33/34, and 35/36, 1942.

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"We, the independent, unattached stampers, realize that steel producers are making every effort to increase sheet and strip output as rapidly as possible. . . .

"It would be a sorry solution to impose controls, if only temporary ones, that are obviously contrary to American principles of free enterprise. Therefore, PMI advances two suggestions:

"(1) That steel producers accelerate their splendid efforts to increase production of sheet and strip. (2) That the stamping manufacturers — who are the end users of vast quantities of sheet and strip — appoint a committee to work closely with an independent organization from the steel industry in the conduct of an impartial investigation seeking means to subjugate the gray market."

Vitro names Lenchner director of market research

The appointment of Theodore Lenchner as director of market research and advertising has been announced by The Vitro Manufacturing Company, Pittsburgh, Pa., manufacturers of colors for the ceramic industries.

Lenchner joined the Vitro organization in 1932. He has been a member of the American Ceramic Society since 1923.

Product improvement through the use of porcelain enamel

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balanced and capable of manipulating loads up to 150 to 200 lbs. in weight, including the firing flanges.

Artificial gas fuel is used and the furnace hearth has been known to last without replacement as long as two to three years. The cost of this comparatively high priced fuel, considering the long life of the furnace hearth, gives an overall cost that is on par with other fuels. The size of the furnace hearth is 10 feet long, 26 inches wide and 11 inches in height. Under present costs of artificial fuel, the furnaces are operated at an hourly rate of 85 cents, so that the firing cost of a small dial is indeed very low. This is an open type of furnace with combustion under the hearth.

Imaginative engineers can find plenty of use for porcelain enamel, as there are many products which now use dials and other small parts that do not prove as efficient. Small signs for outdoor use, agricultural equipment, tree tags, any printed information that must stand weather, should have only one specification — and that is porcelain enamel finish. We believe that if intelligent and comprehensive information is passed on to the product engineer that a thousand more uses can be opened up to porcelain enamel.

PEI annual forum for plant men

(Continued from Page 37)

tion, stated Trubey, emphasizing, however, that there can be "under consumption" if the lower income levels have no security. "We can't have a strong democracy when millions have nothing," he added.

Trubey then explained the history behind the profit sharing plan inaugurated at Baltimore Porcelain Steel in 1944. At the present time, 25 per cent of the company's profits before taxation are placed in the profit sharing fund, with the firm putting in $3 for every $1 put in by each employee. If an employee contributes the maximum of $200 a year into the fund, the company contributes an additional $600 to the fund in the employee's name.

When employees have a stake in their business, their physical efficiency will reach 90 or 100 per cent, said Trubey, adding that he couldn't "see any company losing money if all employees are interested in it." He summed up his discourse by venturing that the United States can never be defeated if every individual has a stake in the capitalistic system. His closing remarks of "If you don't want a man to be a communist, make him a capitalist" were greeted by a large ovation and a standing vote of acknowledgment from the enamelers for an inspiring speech.

Burning tools, drying, government research discussed

Dr. E. E. Marbaker, O. Hommel Co. Fellow, Mellon Institute, presided at the Friday morning session when the following papers were presented: "Design, Construction and Maintenance of Burning Tool Equipment," by A. Rasmussen, The Fahralloy Co.; "Survey of Drying Practices in the Porcelain Enamel Industry," by George N. Tuttle, Benjamin Electric Mfg. Co.; "Common Defects in Porcelain Enamels Occurring in Processing and How to Repair Them for the Finish Line," by John L. McLaughlin, Chicago Vitreous Enamel Product Co.; "Applications of Ceramic Coatings to Aircraft Power Plant Construction," by Major R. A. Jones, Air Materiel Command, U.S.A.F.; and "Development of Porcelain Enamel Coatings on Metals for Navy Shipboard Service," by Forrest R. Nagely and J. R. Chilcote, Bureau of Ships, U.S.N. Nagely presented the paper which featured the technique of "flame spraying" of porcelain enamel upon which continued research is being carried out. The "flame spraying" technique was illustrated with color movies.

Due to the length of the papers at this session, the last forum paper by Allen C. Francisco, PEI Fellow, National Bureau of Standards, was held over to the afternoon session. His paper was a "Progress Report on Porcelain Enamel Research at the National Bureau of Standards."

Board of experts

Following the last paper, a board of experts took over the final session, with Dr. G. H. McIntyre as master of ceremonies. Members of the board were A. S. Ault, Chicago Vit; Roy Beck, O. Hommel Co.; H. L. Cook, Ingersoll Steel; Prof. R. L. Cook, U. of I.; Karl Kautz, Climax Molybdenum; Rudyard Porter, Carnegie Illinois; Marcel Pouilly, DeVilbiss; C. P. Scripture, Ing-Rich; E. H. Shands, Roper Corporation; J. B. Willis, Pemco; and Mike Bozsin, Ferro Enamel, substituting for Wm. Noble.

Some of the advice and opinions which the experts passed on to their fellow enamelers in the "quiz session" are as follows:

The life of a nickel tank depends on the efficiency of filtration. Tanks should be dumped when a uniform coating can no longer be secured. — Refire does not affect the adherence of titanium enamel. — Finer grinding of frit is one answer to better atomization. — There is a new dry drawing compound on the market which will wash off with hot water. — Small town plants have the best trained personnel. — On changing to titanium type enamels, product design should be checked. Easing of radii

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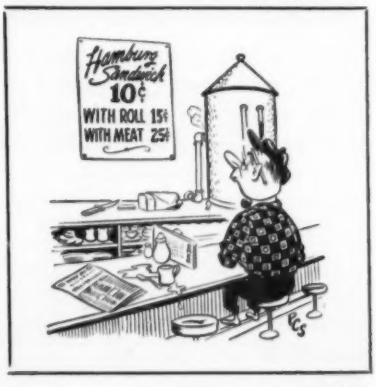

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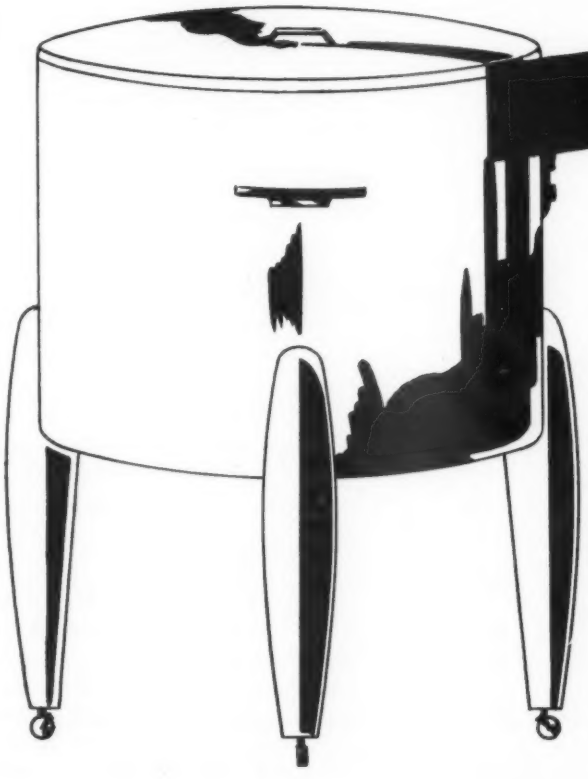

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